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13. ABSTRACT *(Maximum 200 words)*

The principal goal of this project is to document the utility of the Total Army Injury and Health Outcomes Database (TAIHOD) in measuring deployment-related health outcomes and risk factors for adverse health events. A secondary effort is to link self-reports of stress and subsequent increases in morbidity.

In our first year we have demonstrated the utility of the TAIHOD in assessing baseline (prewar) characteristics of deployed and non-deployed Gulf War era veterans, information critical to the interpretation of postwar differences between these two groups. We have identified potential sources of threats to internal validity with regard to studying rates of illness hospitalizations among deployed and non-deployed veterans. We are exploring ways to use the TAIHOD to evaluate data quality -- information important to several Gulf War health researchers and which has led to our collaboration with several other federally funded Gulf War health researchers.

We found no evidence of excess stress or distress among deployed veterans in the period prior to deployment, although there is evidence of greater risk-taking. We are focusing our efforts on postwar behavior changes and self-reported experiences of stressors and distress in order to identify possible links between these factors and Gulf War Illnesses.

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5. Introduction

The purpose of this project is to evaluate the utility of the Total Army Injury and Health Outcomes Database (TAIHOD) as a tool for identifying factors related to morbidity and mortality of soldiers who served in the Persian Gulf during Operations Desert Shield/Desert Storm (ODS/DS). The TAIHOD contains information about all active duty Army soldiers from 1980 on, including demographic and personnel information, hospitalization records, deaths, disability discharges, accidents, and records from the Comprehensive Clinical Evaluation Program (CCEP) for Gulf War veterans. For approximately 15% of the Army the TAIHOD also includes self-reported health habits as measured by the Army Health Risk Appraisal (HRA). The HRA includes measures of stressors and distress, which are of particular interest as variables that might explain the development of Gulf War Illness, and other factors that may modify the experience of these symptoms and conditions.

This progress report details our accomplishments over the past year, reports progress on each of the goals outlined in our original statement of work, and delineates our plans for future analyses. The first year has been spent in scrupulous efforts directed toward data cleaning and defining our outcome variables, establishing relationships with a team of collaborators, and accomplishing our preliminary analyses. We have, as we expected, found the TAIHOD to be a useful tool in studying morbidity and mortality among Gulf War veterans, across a wide range of health outcomes that are of concern to this population. Given the documented excess mortality due to injury among veterans, and considering that the TAIHOD was originally designed to evaluate the impact of injuries on the health of the Army, the TAIHOD appears to be a particularly useful tool for tracking trends relating to injury outcomes among Gulf War veterans. Because it is such a uniquely rich source of data, however, the TAIHOD has also proven to be useful in tracking other health outcomes (e.g., hospitalizations for symptom-based conditions more common among veterans of Operation Desert Shield/Desert Storm), as well as measures of stressors and distress among soldiers. Moreover, because the TAIHOD contains such comprehensive data on all soldiers who have served on active duty in the Army since 1980, we will ultimately be able to compare soldiers deployed to the Gulf to soldiers deployed to other conflicts or to peacekeeping missions. Finally, by working with the TAIHOD over the past year, and by conducting a thorough search of the literature on Gulf War Illnesses, we have identified gaps in the existing base of knowledge and research into these conditions. We intend to use the power of the TAIHOD to further validate the integrity of data sources commonly used by all Gulf War researchers, to further explore the link between service in the Gulf and injuries, and to clarify the association between self-reported stressors and distress and risk of symptom-based illnesses commonly reported by Gulf War veterans.

6. Gulf War Annual Progress Report

This Document details accomplishments vis-a-vis the approved Statement of Work for the study entitled "Stress, Behavior, and Health: Developing a Model for Predicting Post-deployment Morbidity, Mortality, and Other Adverse Outcomes." Grant # DAMD17-98-1-8610 from the US Army Medical Research Acquisition Activity (USAMRAA).

Statement of Work, Goal #1

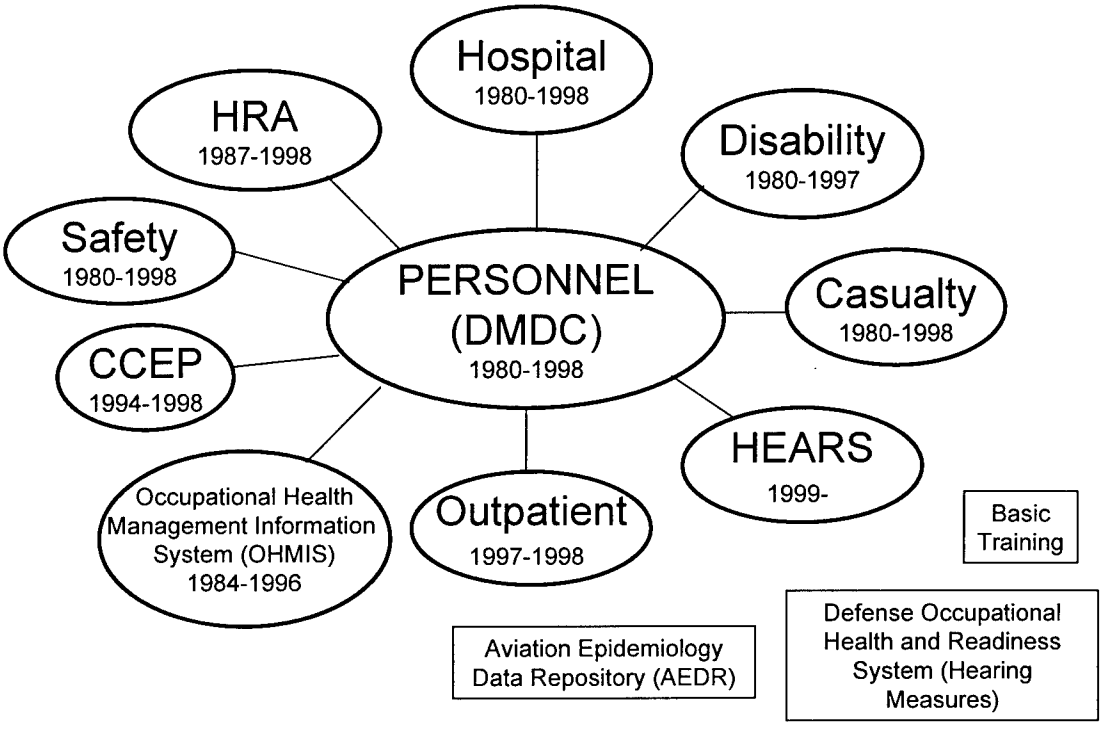
In the first 3 months of this project we said we would integrate the new semi-annual DMDC data; acquire new HRA data (through 1996) and link to the TAIHOD; error check new data; acquire CCEP data and link to the TAIHOD; scramble unique identifiers; and construct measures of stressors, distress, functional status, effect modifiers, and the outcome variables (Gulf War Illness). We said we would establish good collaborative relationships with our team consultants.

Progress Goal #1A:

We have obtained and integrated all the data indicated in our first statement of work goal. In addition, we were able to obtain HRA surveys into 1998 and are in the process of obtaining additional, newer HRA surveys. The HRA survey program is being phased out and will be replaced by the Health Enrollment Assessment Review (HEAR) survey, a similar health behavior survey that is being implemented throughout the DoD. We have begun obtaining Army HEARS data to evaluate how they can be linked to the TAIHOD and will continue with this effort.

Figure 1 depicts the databases currently contained in the TAIHOD and the dates for which we have information in each linked dataset. All working datafiles have been scrubbed of unique identifiers. In order to further safeguard the soldier's privacy, security systems have been added to reduce access to the area where analyses are conducted.

Figure 1. The TAIHOD Database



Progress Goal #1B:

We have obtained the CCEP data and deployment files for all active-duty soldiers from the DMDC and linked these data to the TAIHOD. The deployment files provide dates of deployment to the Gulf War theatre of operations as well as re-deployment dates. It is the datafile most commonly used by investigators researching Gulf War Illnesses to document "exposure" or service in the Gulf War. Though this datafile is widely used, we have been unable to identify studies that validate these data. To address this concern, we have developed a collaborative relationship with two other federally funded Gulf War research teams: The Iowa Persian Gulf Study Group and the Boston Environmental Hazards Center (following the Ft. Devens cohort). We are planning to collaborate with them on a validation study to compare the DMDC activation information to the self-reported information obtained through personal interviews by these two groups, in order to determine the integrity of the deployment file on which so many research teams have come to depend. Of greater concern than the potential for general misclassification is the possibility of a more systematic pattern of errors. If miscoding did occur in the DMDC files, for example, it is entirely plausible that it will be differential with regard to branch of service (Army, Navy, USAF, USMC) and component (Active, Guard, Reserve). It is also possible that individual subgroups will reflect varying levels of data quality by gender, officer/enlisted, race, or occupation (infantry, medical, transportation, etc.). Should we find evidence of poor data quality, categorizing it will be of use to many ongoing research projects. Also, we may need to find other ways to document exposures. In particular, we are worried about bias in this measure that might have led to spurious findings of increased risk for Gulf War Illnesses among some groups but not others.

If we identify problems with the DMDC data it may mean that no changes or improvements will be possible. But having even limited understanding of the nature of the inaccuracies of these files will be

useful in revising our analysis plan and may influence the interpretation of studies that have been done already. We believe that the information to be gained from this will be useful to all of us who are devoted to deployment research. While this is an admittedly tedious process and certainly not the most glamorous aspect of epidemiological research (which may be why steps such as these are so often bypassed), it is of critical importance to the ongoing research effort.

Progress Goal #1C:

Because we have also determined that the study could be enhanced through linking active duty health records with Veteran's Administration (VA) data on Army Gulf War veterans, we have explored the feasibility of obtaining and linking Army Gulf War veteran health records to the TAIHOD. This was not possible, however, because the VA is precluded from releasing health data that contains individual identifiers, even to other DoD agencies. The research challenges posed by obtaining health outcomes and exposure data across administrative agencies and services has been documented in the Gulf War literature (1). In spite of the difficulties we encountered, we were able to do limited collaborative analyses with the VA, which provided insight into sample selection issues. We sent TAIHOD data to the VA for an analysis that documented which members of the Army, grouped in several different ways, ultimately ended up in the VA system and which of these received a diagnosis other than healthy. Table 1 details the findings from this effort.

Table 1. Findings from matching with the VA Gulf Registry.

COHORTS (TAIHOD)	Percent discharged from the Army on or before 6/30/98	Percent of discharged registered with VA	**VA Through 1996**		**VA After 1996**	
			Symptoms	Any Diagnosis	Symptoms	Any Diagnosis
1. Army CCEP registrants healthy (n = 10,703)	55.8%	7.5%	95%	80%	91%	79%
2. Army CCEP registrants diagnosis other than healthy (n = 22,056)	52%	5.0%	97%	84%	92%	79%
3. Not in CCEP registry but took HRA pre-ODS/DS (n = 23,546)	75.5%	1.4%	94%	74%	85%	77%
4. Not in CCEP registry but took HRA post-ODS/DS (n = 223,624)	61.5%	2.2%	93%	75%	75%	88%
5. Not in CCEP registry and no HRA data (n = 556,517)	87.7%	4.0%	94%	76%	88%	73%

The study effort was challenging for several reasons. First, rules established to protect the anonymity of the veterans precluded transfer of data with any individual identifiers from the VA to the TAIHOD research group. Transfer of the TAIHOD to the VA would have been very difficult due to the enormous size of the database and confidentiality agreements established in the development of this database. To address these concerns the TAIHOD research team created several cohorts that included unique identifiers

(SSNs), but no other indicator information other than an assigned label of "cohort 1", "cohort 2", "cohort 3," and so on. These were sent to the VA to be matched with their files. The first group comprises individuals who match to the DMDC personnel files, are registered with the CCEP program, and have received a primary diagnosis of healthy. The second group includes soldiers who again match to the DMDC personnel files, have registered with the CCEP, and have been given a primary diagnosis other than healthy. The third through fifth cohorts were not in the CCEP registry. Because we were interested in evaluating the potential for selection bias related to administration of an HRA these three groups were developed around whether or not they had taken an HRA. The third group includes soldiers not registered with the CCEP, but who took an Army HRA prior to ODS/DS. The fourth cohort includes soldiers not registered with the CCEP, but who have taken an HRA since the end of ODS/DS. Finally, the fifth group comprises individuals who are not registered with the CCEP and for whom we have no HRA information, either before or after ODS/DS. These cohorts are not mutually exclusive.

A second challenge we faced related to changes in the VA Persian Gulf registry data collection system. A new code sheet was developed in 1996. The VA informed us that differences between the old and new forms were so drastic that combining the results from these two formats would have been impossible. Thus, results from both the early and later coding efforts are displayed separately in Table 2. Finally, the VA Gulf Registry does not contain a specific indication of whether an individual is healthy per se, thus we focused on presentation of any symptoms and whether or not any diagnosis was made.

Overall, 3.5% of the list of Army soldiers sent to the VA matched the VA's registry (reflecting soldiers who self-selected to register with the VA). Twelve and a half percent of those who registered with the CCEP while on active duty also registered with the VA after the war. Those given a diagnosis of normal in their CCEP evaluation appear to be slightly more likely to register with the VA after discharge from the Army. Seven and a half percent of this group (the first group: individuals in the CCEP registry with a primary diagnosis of healthy) are also found in the VA Persian Gulf registry file. Over 90% of these individuals reported symptoms in the VA Gulf Registry data and about 80% received a diagnosis. Five percent of the second group (those in the CCEP with a diagnosis other than healthy) registered with the VA. Not surprisingly, this group appeared to be more likely to report symptoms. It is not clear with these data if they were more likely to receive any diagnosis, however. Ninety-two to ninety-seven percent reported symptoms and 79%-84% received a diagnosis. Approximately 1.4% of the third group (those not in the CCEP registry, but for whom we have prewar responses from the HRA survey) registered with the VA following their discharge from the Army. Eighty-five to ninety-four percent of them reported symptoms and 74%-77% received a diagnosis. Our fourth cohort (those not in the CCEP, but for whom we have postwar HRA survey responses) showed the greatest variation in reported symptoms and diagnoses between the early and later VA data forms. A little more than 2% of this group ultimately registered with the VA; 75%-93% of them reported symptoms and 75%-88% of them received a diagnosis. We know the least about the fifth cohort (those not registered with CCEP and for whom we have no HRA, either before or after the war). Three and a half percent of this group registered with the VA; 88%-94% reported symptoms and 73%-76% received a diagnosis.

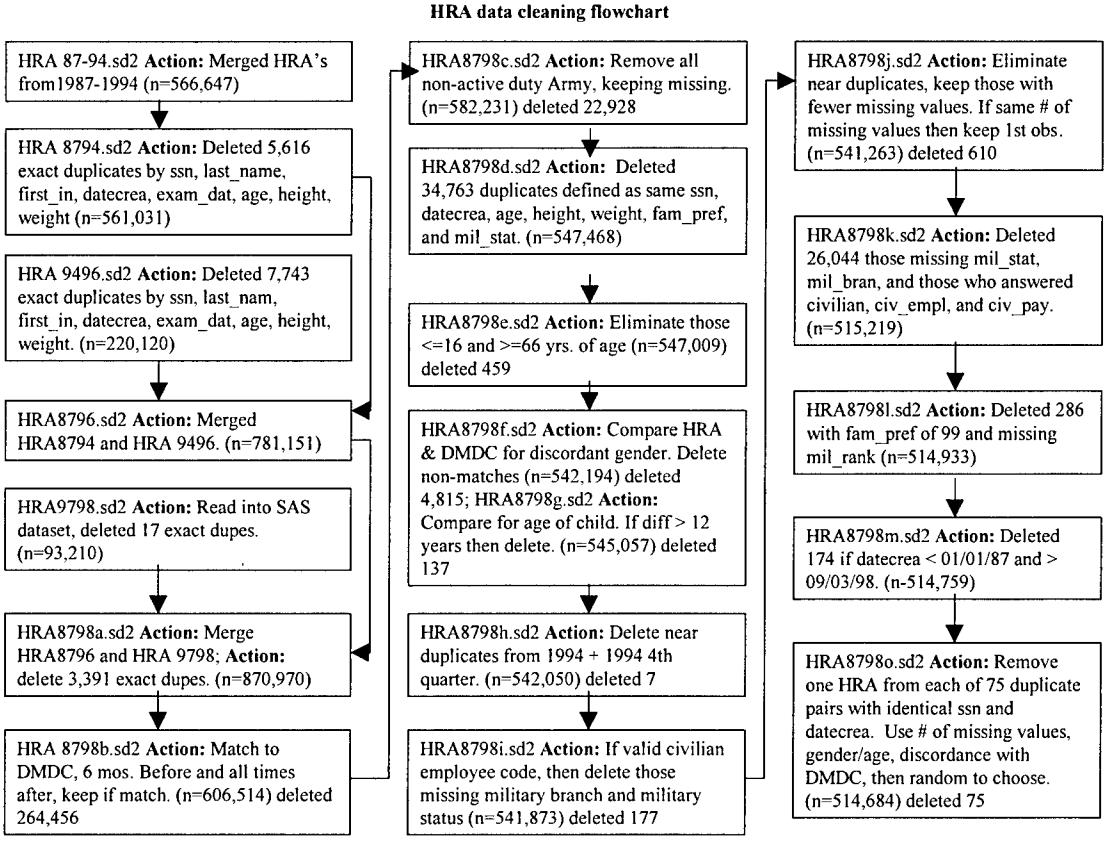
Overall, very few members of the Army ultimately end up in the VA registry (the table above demonstrates that, in fact, the percentage of people who left the Army is much higher than the percentage of people who ultimately registered with the VA). This suggests that we may not be missing much in terms of potential lost follow-up of soldiers. Our HRA study cohorts do not appear to be very different in terms of the likelihood of entering the VA registry after leaving the service. Those who did not take an HRA were slightly more likely to register than those who had taken an HRA either before or after ODS/DS. This probably reflects the slight sampling bias involved with the HRA group where officers are slightly over-represented among HRA takers. These same factors have also been shown to be associated with lower risk for registration with the VA's Gulf War registry (2).

Progress Goal #1D:

We engaged in an intensive and scrupulous process of error checking and review of each additional datafile before linking them to the TAIHOD. The HRA records proved to be particularly challenging in this regard, as there were duplicate and near-duplicate records, as well as records for both active duty soldiers and their dependents in the datafiles we received from the Center for Health Promotion and

Preventive Medicine (CHPPM). We took a restrictive approach to removing duplicates and near-duplicates, as well as individuals suspected of being non-active duty. Details on the steps taken to prepare this database for analyses may be found in Figure 2.

Figure 2. HRA Data-cleaning process



Progress Goal #1E:

A necessary part of our initial analytic efforts was the creation of measures of stressors, distress, functional status, and effect modifiers. Several items on the HRA survey questionnaire attempt to measure stressors, distress, or functional status. In order to develop parsimonious models using these variables we began with *a priori* consideration of which items might best be grouped to capture soldier responses along a single dimension (e.g., stressors). This was done in committee fashion including a psychologist with special expertise in survey research methodology; a psychiatrist who was deployed to the Persian Gulf; two other physicians (one with extensive experience on active duty in the Army, the other with extensive experience conducting research related to the health of Gulf War veterans); a biostatistician; and five epidemiologist/program evaluation researchers with masters or doctoral level training, experience with the TAIHOD, and familiarity with the Gulf War literature.

The initial groupings proposed by this committee were confirmed with factor and cluster analyses. We used a decision rule such that groupings with coefficient alphas equal to or greater than 0.70 provided support for the grouping. Otherwise, variables were left ungrouped. This approach was initially used on a small group of soldiers who completed HRAs before the Gulf War. We used these results in the development of our first manuscript, "Demographic, physical, and mental health factors associated with deployment of US Army soldiers to the Persian Gulf," currently under review at *Military Medicine* (see Appendix D). We are in the process of defining effect modifiers and confounders in a similar fashion for our next analytic efforts.

Progress Goal #1F:

We have also taken steps to evaluate the quality of the HRA data since, to our knowledge, there have been no attempts to establish the reliability and validity of these data. As a first step, we have begun to trace the history of the development of the HRA survey questionnaire. We have learned that the questionnaire is based on the CDC's Behavioral Risk Factor Surveillance System (BRFSS) survey instrument, which was customized for use by the Army in the mid- to late-1980s. We have spoken with various members of the committee who were tasked with the customization of this survey for the Army, and its development and implementation through the Army's *Fit to Win* program.

We have initiated several analytic projects in an effort to evaluate the reliability and/or validity of various HRA measures. We have compared a sample of responses to HRA items to related measures on the medical records of soldiers who took an HRA. We have also completed an assessment of hospitalizations for psychiatric conditions and responses to HRA items measuring stress and distress among all active duty Army who took an HRA (see Table 2). In addition, we have undertaken a series of analyses to better evaluate the external validity of our findings (see Table 4 below and Tables A-K in Appendix A, and Figures A-P in Appendix B), to determine how representative the HRA takers are (and thus how generalizable the findings are to other active duty Army).

The comparison of HRA responses to medical records was accomplished in a project led by one investigator and two technicians who traveled to St. Louis to examine personnel and health records stored at the Veterans Administration Records Management Center and the National Archives Records Administration National Personnel Center (NARANPC). The research team spent 2 weeks reviewing 1,200 personnel and medical records. Data was extracted onto a hard copy record and subsequently entered into a computerized database.

Through these validation efforts we found that the extraction and use of data from these records must be approached with care. Some of the files were missing altogether, while others consisted of only empty records jackets. While we found the number of records available sufficient to meet our goal of obtaining sufficient information to validate several variables in the TAIHOD, the records may be of less use for clinical studies or follow-up. We did find, for example, that the records generally contained sufficient information to validate the following characteristics: height, weight, tobacco and alcohol use, age at menarche, family cancer history, last physical exam, serum cholesterol, last mammogram, name, and date of birth. Upon analysis of these data, we may find other factors with adequate information for validation purposes. Final analysis of this database is pending.

The condition of these records may be of interest to other Gulf War Illnesses research efforts. The Office of the Special Assistant to the Deputy Secretary of Defense for Gulf War Illnesses, in their second annual report, cited the discovery of veterans' medical records in the St. Louis NARANPC as an important achievement of the past year (3). While locating these records may greatly expedite their retrieval and analysis, large efforts to perform clinical studies using these records may be best served by first implementing a pilot investigation of the data quality and availability before large-scale investigations get underway.

We have also collaborated with Mr. Brad Taft from CHPPM to evaluate the HRA measures of stress and distress. Table 2 summarizes findings from a comparison of HRA responses to stress-related measures and subsequent hospitalization for the psychiatric condition of Adjustment Disorder (ICD-9 CM code = 309). We matched a dataset of Adjustment Disorder hospitalizations for active duty soldiers in 1992 (n = 21,083) to pre-hospitalization HRAs taken from 1987 to 1992 (n=18,862). The final dataset comprised 296 records, and we performed a univariate analyses of selected HRA items and hospitalizations with a primary diagnosis of adjustment related disorder occurring subsequent to the HRA.

Table 2. Comparison of HRA responses to stress-related items and subsequent hospitalization for adjustment disorder

HRA ITEM	RESPONSE		RANDOM SAMPLE	HOSPITALIZED	ODDS RATIO
12. Marital status	1	Married	163	113	
	2	Never married	95	129	1.44
	3	Divorced	21	30	
	4	Separated	3	11	Set(s)
	5	Widowed	0	0	{2,3,4,5,6}
	6	Other	0	3	
	■	*Missing*	14	10	
	■	*TOTAL*	296	296	
39. I am satisfied with my present job assignment and unit.	1	Not satisfied	33	70	
	2	Somewhat	60	75	2.12
	3	Mostly	91	73	
	4	Totally	50	23	Set
	5	Not applicable	50	44	{1}
	■	*Missing*	12	11	
	■	*TOTAL*	296	296	
40. What causes the biggest problem in your life?	1	Money	106	98	
	2	Social life	12	31	
	3	Family	18	37	1.75
	4	Supervisor	14	10	
	5	Job	30	49	Sets
	6	Health	16	12	{2,3,4}
	7	No problem	89	53	
	■	*Missing*	11	6	
	■	*TOTAL*	296	296	
41. In the last year, how many serious personal losses or difficult problems have you had to handle (example, promotion passover, divorce/separation, legal or disciplinary action, bankruptcy, death of someone close, serious illness/injury of a loved one, etc.)	1	Several	39	81	
	2	Some	47	65	
	3	Few	111	73	1.68
	4	None	90	71	
	■	*Missing*	9	6	Sets
	■	*TOTAL*	296	296	{1,2}
42. In general, how satisfied are you with your life (e.g., work situation, social activity, accomplishing what you set out to do)?	1	Not satisfied	14	54	
	2	Somewhat	64	91	3.79
	3	Mostly	157	115	
	4	Totally	51	31	Set
	■	*Missing*	10	5	{1}
	■	*TOTAL*	296	296	

HRA ITEM	RESPONSE		RANDOM SAMPLE	HOSPITALIZED	ODDS RATIO
43. How often are there people available that you can turn to for support in bad moments or illness?	1	Never	7	20	
	2	Hardly ever	23	57	
	3	Sometimes	95	108	2.56
	4	Always	160	101	Sets
	■	*Missing*	11	10	{1,2}
	■	*TOTAL*	296	296	
45. Have you seriously considered suicide in the last two years?	1	Yes	6	27	
	2	Yes, within the last year	2	23	7.33
	3	Yes, within the last 2 months	0	9	Sets {1,2,3}
	4	No	278	229	
	■	*Missing*	10	8	
	■	*TOTAL*	296	296	
46. How often do you have any serious problems dealing with your husband or wife, parents, friends or with your children?	1	Often	13	39	
	2	Sometimes	49	85	
	3	Seldom	114	100	2.96
	4	Never	111	67	
	■	*Missing*	9	5	Set
	■	*TOTAL*	296	296	{1}
48. How often has life been so overwhelming in the last year that you seriously considered hurting yourself?	1	Often	2	24	11.92
	2	Sometimes	6	33	Set
	3	Seldom	16	44	{1}
	4	Never	264	189	----------
	■	*Missing*	8	6	----
	■	*TOTAL*	296	296	7.08
					Set
					{1,2}
49. In the past year, how often have you experienced repeated or long periods of depression?	1	Often	8	60	
	2	Sometimes	30	74	
	3	Seldom	91	76	7.43
	4	Never	159	81	
	■	*Missing*	8	5	Set
	■	*TOTAL*	296	296	{1}
51. How often are you able to find times to relax?	1	Often	59	40	
	2	Sometimes	153	122	
	3	Seldom	67	106	1.69
	4	Never	7	20	Sets
	■	*Missing*	10	8	{3,4}
	■	*TOTAL*	296	296	

These results indicate a high degree of criterion-related validity, or the predictive power of these items. While we cannot comment on how well these items measure true states of distress or experiences of stressors, these results provide evidence that the stress-related measures are capable of predicting outcomes consistent with experiences of stress, distress, or difficulties coping (i.e., state or personality related factors).

External validity of the HRA population has also been a focus of our review and evaluation efforts. Though the HRA is not administered to everyone, the process by which individual soldiers take an HRA does not appear to be overly biased toward one particular group or another. Most soldiers complete an HRA as part of in-processing to new bases or assignments. The second most common mechanism for administration is also through routine periodic physical exams or physical fitness testing activities. A smaller portion (5.5 %) is administered when a soldier is visiting a walk-in or occupational health clinic (see Table 3).

Table 3. Distribution of HRAs by reason for taking the HRA

Reason	Frequency	Percent
Missing	5,180	1.3
In-processing	238,780	59.1
Physical Exam	73,706	18.3
Pre-APFT	2,739	0.7
Occupational health clinic visit	9,604	2.4
Walk-in	12,648	3.1
Other	61,081	15.1
Total	403,738	100.0

Because those taking an HRA as part of a medical care visit might be sicker than those taking the HRA for other reasons, we explored this potential source of bias by comparing pre-HRA hospitalizations by reason for taking the HRA. These results show that 7% of people who were hospitalized before taking an HRA and 7% of those who were not hospitalized before taking an HRA took the HRA at a walk-in or occupational health clinic (see Table 4). Thus, there is no evidence of a bias towards selecting sicker individuals to take the HRA, based on prior hospitalizations.

Table 4. Hospitalization status prior to HRA stratified by reason for taking the HRA

Reason	No hospitalization prior to HRA		Hospitalization prior to HRA	
	N	Percent	N	Percent
Missing	1,527	1.2	1,437	1.4
In-processing	56,345	45.2	43,582	41.4
Physical exam	34,169	27.4	31,839	30.2
Pre-APFT	900	0.7	864	0.8
Occupational health clinic visit	4,191	3.4	3,674	3.5
Walk-in	4,733	3.8	3,435	3.3
Other	22,705	18.2	20,390	19.4
TOTAL	124,570	100	105,221	100

To further evaluate the external validity of the HRA data, we also compared the demographic data for those on active duty with the Army who took an HRA to those who were on active duty but did not take an HRA. Because most of these characteristics are time varying (e.g., age changes, rank may change), it was necessary to make annualized comparisons. Tables A-K in Appendix A detail the demographic characteristics of HRA takers and non-takers in each year from 1987 through 1997 (see Appendix A). During the first few years in which the HRA was administered (1987-1989) there were very few HRAs (1987 n = 272, 1988 n = 43, 1989 n = 74). These were essentially "pilot testing" years. Thus, the demographic profiles in these early years are different from the population at large and from later years of HRA administration. In these early years, older, white, married officers were quite over-represented.

From 1990 on there were much smaller differences in the demographic characteristics of HRA takers and non-takers. However, the tendency to over-sample officers and those with a college education has persisted across time. Also, there appears to be an over-sampling of people with a "white" ethnic/racial background, though not consistent across all time periods. These differences were fairly small but did persist over time.

Figures A-H in Appendix B depict the temporal changes in the distribution for key demographic variables among those who took an HRA. Figures I-P provide annual demographic distributions among those not taking an HRA in each year, for comparison. These findings indicate that, overall, the Army is getting older and the proportion of females and people with college degrees is increasing. HRA takers are also getting older, and the proportion of people with college degrees is also increasing.

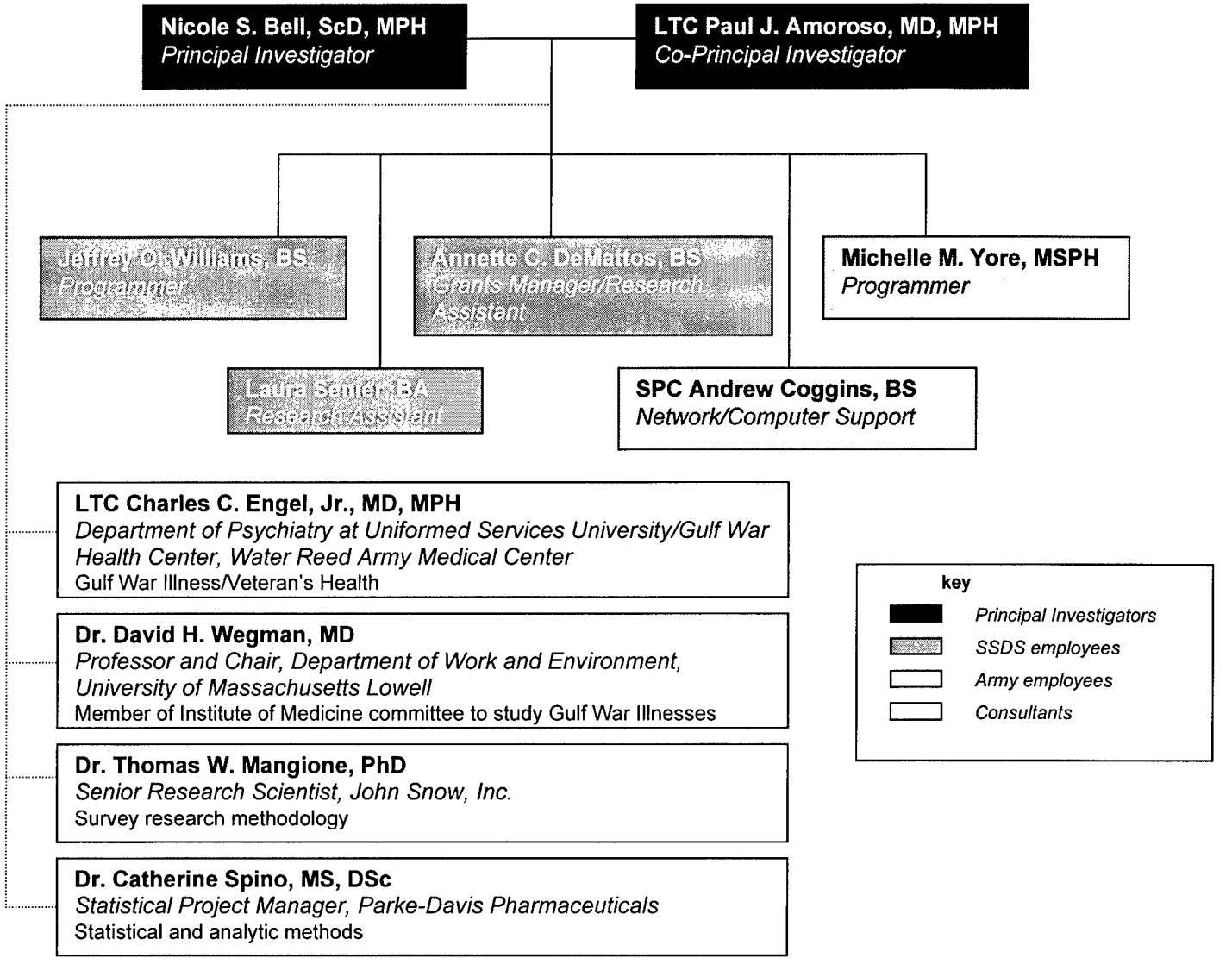
Progress Goal #1G:

One of the more challenging tasks we have tackled related to our first statement of work goal was the development of outcome variables that measure Gulf War Illnesses. There is no agreement in the medical or research community about what constitutes a Gulf War Illnesses (4). To construct our working definition, we reviewed a number of potential approaches currently used by various investigators, again with the help of our multidisciplinary committee. We debated the relative merits of the approaches and identified the strengths and weaknesses of each. We ultimately determined that we would use more than one approach, depending upon the needs of our specific research objectives. The most frequent diagnoses made to veterans seeking care in the CCEP program (other than diagnoses of "healthy") comprise one outcome measure. For certain analyses we developed another working definition that incorporates CCEP diagnoses as well as other key outcomes of interest. Appendix C summarizes the decisions our group used to create these working definitions of Gulf War Illnesses. We expect to incorporate this outcome measure in our future analytic efforts modeling factors, which predict postwar development of Gulf War Illnesses.

Progress Goal #1H:

Perhaps the most important accomplishment related to this goal in our statement of work is the establishment of collaborative working relationships with several experts in the area of Gulf War Illness. We meet regularly with Dr. (LTC) Charles Engel (Chief, Gulf War Health Center at Walter Reed Army Medical Center and Assistant Professor of Psychiatry at the Uniformed Services University), Dr. David Wegman (Professor and Chair, Department of Work Environment, University of Massachusetts Lowell, and member of IOM committee to study Gulf War Illnesses), Dr. Thomas Mangione (Senior Research Scientist, JSI Research and Training Institute, and renowned authority on survey research methodology), and Dr. Catherine Spino (Statistical Project Manager, Parke-Davis Pharmaceutical Division). In addition, we have hired a part-time computer programmer working towards his master of science degree in epidemiology (Mr. Jeffrey Williams) and a part-time research assistant who will complete her master of public health degree in May of 2000 (Ms. Laura Senier). Also, USARIEM computer programmer, Ms. Michelle Yore, and computer network specialist, SPC Andrew Coggins, have become integral team members. We have pulled together a strong multidisciplinary team to work on the many issues related to understanding the factors that influence the health of Gulf War veterans. Figure 3 describes the research team.

Figure 3. Gulf War Illnesses Research Team



Statement of Work, Goal #2

Evaluate trends (1980-1997) for ICD-9 coded inpatient hospitalizations most often included in lists of Gulf War Illnesses diagnoses. Assess influence of the Gulf War on these rates.

Progress Goal #2:

We have begun to analyze trends in prewar hospitalizations among veterans deployed to the Gulf as compared to those not deployed to the Gulf. We have examined hospitalizations for conditions commonly experienced by soldiers who deployed to the Gulf (as documented in the CCEP registry). We are comparing the rates for hospitalizations prior to the Gulf War among soldiers who ultimately deployed to the Gulf to those who were not deployed. We are also exploring the influence of external events on these rates, such as media coverage of the Gulf War, as well as coverage of military downsizing and sexual harassment in the military. The manuscript from this effort is in development, and we expect to submit it to a journal for review on or around August 15, 1999. A review of the preliminary findings from this analysis may be found in Appendix F.

Statement of Work, Goal #3

Analyze individual characteristics to determine how well these factors explain variation in the development of Gulf War Illnesses among the entire active duty population, independent of deployment status. Develop a manuscript discussing the baseline level of conditions (1980-1997) commonly included in definitions of Gulf War Syndrome. Note changes in prevalence of these conditions following deployment and control for demographic characteristics, occupation, risk exposure, and other job factors.

Progress Goal #3:

We are currently examining not only individual data but also group data (i.e., exposures experienced by the entire cohort, or large segments thereof) to better understand factors that influence hospitalization trends for Gulf War Illness. This model is complicated because the error terms for the group-level data are not independent, the need to include several grouped level and individual level data, and to account for lag time in the response to some external events. Appendix F documents findings to date on this effort.

Statement of Work, Goal #4

For the sub-population of Army who have taken an HRA, evaluate whether stress, distress, or health behavior measures improve our ability to predict who will experience Gulf War Illnesses (independent of deployment status).

Progress Goal #4:

We been unable to evaluate extensively the influence of self-reported measures of stress, distress, or health behavior on prewar trends in Gulf War Illnesses due to the relatively small numbers of HRAs in the prewar period. To conduct time-series analyses would require several data points, but our sample of prewar HRA takers is too small. (Table 5 shows the numbers of HRAs taken each year, stratified by deployment status.) Because only those on active duty during the war were theoretically eligible for deployment, we included only these soldiers in our comparison groups. We have, however, been able to demonstrate some differences between those who deployed and those who did not deploy to the Gulf, in spite of our small sample. Our data suggest that, by in large, soldiers who deployed to the Gulf were happier and healthier (e.g., they experienced fewer stressors) than their non-deployed counterparts in the period before the war. Deployers appear to be more likely to engage in risky behaviors (e.g., failing to wear a seatbelt), but these differences do not reach statistical significance. These findings suggest that any decrement in mental health status identified in the postwar period is most likely related to the war or the process of redeployment and was not present before the war or associated with deployment to the Gulf. Evidence of excess risk taking may explain, in part, the excess injury mortality observed among deployers after the war (5). These results are contained in a manuscript currently under review at *Military Medicine* (see Appendix D). They relate to statement of work objectives that we initially planned to execute in the second year of our funding, but because these findings have implications for future analyses and are critically important to our understanding of potential confounders and biases in the data describing deployers and non-deployers, we executed these analyses earlier than originally planned.

Table 5. HRAs by year for the active duty Army GW Era cohort* stratified by deployment status.

Year	Not Deployed	% of Total	Deployed	% of Total
No HRA	271,418	64.94	174,417	67.68
1987	153	0.03	61	0.02
1988	32	0.007	11	0.004
1989	61	0.01	11	0.004
1990	2,105	0.50	1,025	0.40
1991	38,905	9.31	22,361	8.68
1992	42,847	10.25	23,566	9.14
1993	21,796	5.22	12,081	4.69
1994	14,977	3.58	8,623	3.35
1995	12,465	2.98	7,506	2.91
1996	7,776	1.86	4,493	1.74
1997	4,371	1.05	2,801	1.09
1998	1,021	0.24	743	0.29
Total	417,927	100.00	257,699	100.00

** GW Era cohort was defined by being on active duty with the Army during three different observation points, June 1 1990, December 31, 1990, and June 1, 1991. This restrictive approach to defining Gulf War Era members was taken to reduce any potential bias related to individuals leaving the service to avoid serving in the Gulf, and to account for differences in the opportunity for deployment that would exist if a person was not on active duty during the entire ODS/DS time period.*

Statement of Work, Goal #5

Compare health care utilization before the war, occupational and personal attributes, and health behaviors between soldiers who ultimately deployed to those who did not deploy. Document interactions among these factors, service in the Gulf, and subsequent development of Gulf War Illnesses. Develop a manuscript (in year 2) related to these findings.

Progress Goal #5A:

We determined that the efforts described under this statement of work goal really required two separate analytic efforts and would result in two separate products. We focused initially on the factors distinguishing those who deployed from those who did not deploy, since these same factors could influence risk of development of postwar illnesses. Also, we found no other studies in our literature review that documented baseline (prewar) health status of Gulf War era veterans. This information is essential for interpreting any post-war differences that exist between soldiers who deployed and who did not deploy.

While the manuscript for these efforts is not due until next year (according to our statement of work), it has been completed early and is currently under review at *Military Medicine* (see Appendix D). Key findings are summarized under the discussion of our fourth statement of work goal (see above).

We will begin the second portion of these proposed efforts within the next 2 months. As a team we will develop a multivariate predictive model incorporating our findings to date. Because prewar HRAs are sparse, we will focus on measures of stress, distress, and health behaviors taken immediately after the war. We will also incorporate demographic and occupational information, and look for effect modifiers. We are particularly interested in the stressful influence of having a spouse deployed to the Gulf. Soldiers in the most commonly deployed occupational cohorts who were deployed to the Gulf were more likely to have a spouse who was also deployed to the Gulf as compared to soldiers in the same occupational group who were not deployed to the Persian Gulf (see Appendix D). We will also focus our attention on excess risk-taking habits and risk of postwar injury morbidity and mortality, since these seem to be the major health events differentiating Gulf War veterans from other soldiers.

Progress Goal #5B:

Our research findings and observations at the recent conference on federally sponsored Gulf War Veterans' Illnesses Research (June 21-25, Washington, D.C.) inspired the development of another paper related to this research objective. Several researchers have documented the increased risk for non-battle injuries both during and after the war among soldiers deployed to the Gulf (5, 6). Little research to date, however, has documented the baseline (prewar) prevalence of injury among veterans of ODS/DS, or of postwar risk for non-fatal injuries. Similarly, little mention has been made of the curious link between service in the Gulf and increased risk of injury. This is surprising, since elevated injury rates were also documented among veterans of the Vietnam conflict (7-12). Our commentary explores possible reasons to explain this "missing link" in the Gulf War research agenda and recommends research questions in this area that demand further study (see Appendix E).

7. Key Research Accomplishments

- Took special steps to evaluate the integrity of newly acquired datafiles before linking them to the TAIHOD.
- Organized a multidisciplinary team of talented individuals.
- Initiated efforts to document the history of the development of the HRA survey tool and determine the extent to which the survey items have been validated.
- Discovered that prewar prevalence of stressors and self-reported distress are lower among soldiers who deployed to the Gulf than among soldiers who were on active duty during the entire Gulf War period but were not deployed to the Gulf.
- Documented prewar risk-taking behaviors and risk exposures among soldiers who deployed as compared to those who were not deployed to the Gulf, and found evidence of a modest elevation in risk-taking behaviors among deployers.
- Documented lower rates of prewar hospitalizations for conditions commonly reported by Gulf War veterans among those who deployed than among those who did not deploy.
- Established that prewar hospitalizations for injuries appear to be greater among soldiers who were deployed to the Gulf as compared to Gulf War Era veterans who were not deployed to the Gulf. This is suggestive of increased risk-taking behaviors and/or risk exposures (e.g., occupational, recreational) and may explain, in part, the excess injury mortality observed among veterans of ODS/DS during and after the war.
- Conducted preliminary investigations to study the potential influence of external events (such as downsizing or sexual harassment in the military) on hospitalization for conditions commonly reported among Gulf War veterans.
- Identified a gap in research related to rates of injury mortality among Gulf War veterans. Recommended a change in policy and funding incentives to devote more attention to excess injury morbidity and mortality among deployers.
- Identified a lack of information regarding data quality, even for data widely used by many researchers focusing on the health of Gulf War veterans. We are forging collaborative alliances with other research teams to validate the integrity of commonly used data sources.

8. Reportable Outcomes

Manuscripts

Demographic, Physical, and Mental Health Factors Associated with Deployment of US Army Soldiers to the Persian Gulf. Nicole S. Bell, ScD, MPH; LTC Paul J. Amoroso, MC USA; Jeffrey O. Williams, BS; Michelle M. Yore, MSPH; LTC Charles C. Engel Jr., MC USA; Laura Senier, BA; Annette C. DeMattos, BS; David H. Wegman, MD (Under review; *Military Medicine*)

Injuries among Gulf War Veterans: Is it time to reconsider the research agenda? Nicole S. Bell, ScD, MPH; Paul J. Amoroso, MD, MPH; David H. Wegman, MD; Laura Senier, BA (Under review; *JAMA*)

Progress toward academic degrees

Two students are directly supported on a part-time basis by funds from this grant.

Mr. Jeffrey Williams is working towards completion of his master of science degree in epidemiology at University of Massachusetts Amherst.

Ms. Laura Senier will receive her master of public health degree from Boston University in May 2000.

Other educational/training programs

Three members of our team are taking courses through the Epidemiology Research Institute (ERI) summer program:

Epidemiologic data analysis

Survival analysis in epidemiology

9. Conclusions

In conclusion, we have assembled a very comprehensive database about the health status of active-duty Army soldiers by combining information from various DoD sources. These data have been carefully assessed for quality-control purposes and have been judiciously linked to other sources of data to prevent the unintentional inclusion of duplicate records or information on non-active duty individuals. This intense focus on active-duty Army soldiers is appropriate and necessary, given the higher incidence of Gulf War Illnesses among Army soldiers as compared to veterans of the other service branches (2, 13). We have constructed sound working definitions of Gulf War Illnesses and other important outcomes of interest among veterans of the Gulf War. We have determined that the soldiers who were deployed to the Gulf were happier and healthier than their non-deployed counterparts in the period before the war, although they were slightly more likely to have been hospitalized for an injury and to practice riskier behaviors. This was an important analytic step in that it provides some "baseline" information or a benchmark by which we can better evaluate true changes in health status after deployment. We have begun to examine the effect of external events on the rates for hospitalizations related to illnesses common among Gulf War veterans. In particular, we have focused on the influence of media coverage of military downsizing, sexual harassment, and media attention to "a new mystery illness," or a, "Gulf War Syndrome." In the coming year, we will undertake one of the most important pieces of our research agenda, which is to construct a predictive model identifying the factors that might predispose a soldier to contracting a deployment-related disorder, or factors that might protect him or her from such debilitating illnesses. Most importantly, we have achieved one of our foremost objectives, which was to establish the utility of the TAIHOD in studying health outcomes among Gulf War veterans. Because it contains information about such a wide variety of health outcomes, as well as demographic and health behavior factors, we have identified gaps in the existing knowledge base used by all Gulf War investigators. By using the TAIHOD in collaboration with other researchers, we can further explore some of these data concerns. Finally, by comparing the health outcomes commonly experienced among Gulf War veterans, as documented through our own experience with the TAIHOD and the work of other investigators, we have become aware of gaps in the research agenda. We strongly recommend the devotion of additional research into the excess morbidity and mortality attributable to injury among Gulf War veterans. In addition to documenting the extent and nature of the excess injury risk, we need more studies focused on behaviors and exposures likely to influence injury risk and/or injury outcomes such as the use of alcohol, tobacco and other drugs; reckless behaviors; hazardous occupational and recreational exposures; and an assessment of the potential interplay between the injury risk and the symptom-based conditions commonly reported among veterans.

It is clear after 10 years of research, that we may never know the answer to the question, "what causes Gulf War Illnesses?" Our research efforts, however, are directed toward a more comprehensive understanding of the factors that play into the development of deployment illnesses and the factors that modify these conditions (i.e., are protective). The findings from our work will be useful in predicting morbidity and mortality subsequent to future deployments and, we believe, will ultimately facilitate the development of interventions to prevent or reduce morbidity and mortality related to deployment.

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11. Appendixes

NOTE: All Items Contained in the Following Appendixes Are Proprietary and May Not Be Distributed to the General Public.

They should not be cited or otherwise referenced without prior approval from Drs. Bell and Amoroso.

Appendix A. Tables

Table A. 1987 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=272)	No HRA (N=91,1860)
SEX		
Male	87.87%	88.19%
Female	11.40%	10.75%
Unknown	0.74%	1.06%
AGE		
<21	2.57%	17.29%
21-24	9.93%	30.06%
25-30	20.59%	25.22%
31-35	38.24%	12.53%
36-40	17.28%	8.50%
41-45	6.25%	3.65%
46-99	4.04%	1.54%
Unknown	1.10%	1.20%
RACIAL/ETHNIC GROUP		
White	77.94%	65.49%
Black	12.50%	26.08%
Hispanic	5.15%	3.58%
Other	1.47%	1.83%
Asian/Pacific Island	1.47%	1.44%
Indian/Alaskan	0.37%	0.48%
Unknown	1.10%	1.10%
DEPENDENTS		
Member + 1 dependent	18.01%	16.67%
Member + 2 or more	60.29%	37.48%
Member only	20.22%	44.57%
Unknown	1.47%	1.28%
MARITAL STATUS		
Married	76.10%	53.03%
Single	18.75%	42.32%
No longer married	4.04%	3.52%
Unknown	1.10%	1.13%
EDUCATION		
High School/Alternate Education	58.82%	79.98%
College	39.34%	17.92%
Unknown	1.84%	2.10%
GRADE		
Enlisted	70.22%	86.05%
Officer	26.84%	11.11%
Warrant Officer	2.21%	1.78%
Unknown	0.74%	1.06%
TIME IN SERVICE		
< 1 Year	4.78%	13.11%
1-2 Years	5.15%	14.96%
3-5 Years	11.76%	29.16%
6-10 Years	23.90%	18.50%
11+ Years	53.68%	23.22%
Unknown	0.74%	1.06%

Table B. 1988 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=43)	No HRA (N=894,977)
SEX		
Male	90.70%	87.93%
Female	9.30%	10.97%
Unknown	0.00%	1.10%
AGE		
<21	2.33%	16.60%
21-24	0.00%	29.11%
25-30	6.98%	25.56%
31-35	13.95%	13.08%
36-40	23.26%	8.66%
41-45	32.56%	4.13%
46-99	18.60%	1.65%
Unknown	2.33%	1.21%
RACIAL/ETHNIC GROUP		
White	90.70%	64.52%
Black	2.33%	26.65%
Hispanic	4.65%	3.65%
Other	0.00%	2.05%
Asian/Pacific Island	0.00%	1.50%
Indian/Alaskan	0.00%	0.50%
Unknown	2.33%	1.33%
DEPENDENTS		
Member + 1 dependent	18.60%	17.10%
Member + 2 or more	60.47%	38.18%
Member only	18.60%	43.42%
Unknown	2.33%	1.31%
MARITAL STATUS		
Married	79.07%	53.90%
Single	13.95%	41.31%
No longer married	4.65%	3.61%
Unknown	2.33%	1.19%
EDUCATION		
High School/Alternate Education	25.58%	80.91%
College	72.09%	17.03%
Unknown	2.33%	2.06%
GRADE		
Enlisted	41.86%	85.92%
Officer	53.49%	11.15%
Warrant Officer	4.65%	1.83%
Unknown	0.00%	1.09%
TIME IN SERVICE		
< 1 Year	4.65%	12.09%
1-2 Years	2.33%	14.18%
3-5 Years	4.65%	29.08%
6-10 Years	6.98%	19.03%
11+ Years	81.40%	24.54%
Unknown	0.00%	1.09%

Table C. 1989 Demographic Comparison of HRA Takers to HRA Non-Takers

	HRA (N=74)	No HRA (N=889,137)
SEX		
Male	93.24%	87.59%
Female	6.76%	11.34%
Unknown	0.00%	1.07%
AGE		
<21	8.11%	16.71%
21-24	8.11%	28.04%
25-30	6.76%	25.90%
31-35	13.51%	13.37%
36-40	24.32%	8.70%
41-45	29.73%	4.43%
46-99	9.46%	1.69%
Unknown	0.00%	1.16%
RACIAL/ETHNIC GROUP		
White	78.38%	63.54%
Black	10.81%	27.34%
Hispanic	8.11%	3.77%
Other	0.00%	2.12%
Asian/Pacific Island	1.35%	1.56%
Indian/Alaskan	0.00%	0.55%
Unknown	1.35%	1.13%
DEPENDENTS		
Member + 1 dependent	18.92%	17.07%
Member + 2 or more	60.81%	38.37%
Member only	18.92%	43.19%
Unknown	1.35%	1.37%
MARITAL STATUS		
Married	74.32%	54.15%
Single	18.92%	41.03%
No longer married	5.41%	3.64%
Unknown	1.35%	1.18%
EDUCATION		
High School/Alternate Education	47.30%	80.89%
College	50.00%	17.02%
Unknown	2.70%	2.08%
GRADE		
Enlisted	56.76%	85.94%
Officer	39.19%	11.13%
Warrant Officer	4.05%	1.86%
Unknown	0.00%	1.07%
TIME IN SERVICE		
< 1 Year	9.46%	12.89%
1-2 Years	6.76%	12.80%
3-5 Years	8.11%	28.43%
6-10 Years	9.46%	19.57%
11+ Years	66.22%	25.24%
Unknown	0.00%	1.07%

Table D. 1990 Demographic Comparison of HRA Takers to HRA Non-Takers

	HRA (N=3,873)	No HRA (N=853,670)
SEX		
Male	85.54%	87.44%
Female	13.37%	11.52%
Unknown	1.08%	1.05%
AGE		
<21	12.60%	15.77%
21-24	25.33%	27.22%
25-30	28.81%	26.19%
31-35	13.63%	13.93%
36-40	10.02%	9.24%
41-45	5.45%	4.75%
46-99	2.92%	1.78%
Unknown	1.24%	1.12%
RACIAL/ETHNIC GROUP		
White	56.73%	62.88%
Black	28.89%	27.81%
Hispanic	6.97%	3.90%
Other	4.39%	2.17%
Asian/Pacific Island	1.39%	1.61%
Indian/Alaskan	0.46%	0.54%
Unknown	1.16%	1.09%
DEPENDENTS		
Member + 1 dependent	17.12%	17.21%
Member + 2 or more	39.43%	39.34%
Member only	42.11%	42.15%
Unknown	1.34%	1.30%
MARITAL STATUS		
Married	55.33%	55.17%
Single	39.50%	39.84%
No longer married	3.90%	3.78%
Unknown	1.27%	1.20%
EDUCATION		
High School/Alternate Education	75.16%	80.25%
College	22.70%	17.68%
Unknown	2.14%	2.07%
GRADE		
Enlisted	82.13%	85.64%
Officer	14.85%	11.39%
Warrant Officer	1.96%	1.94%
Unknown	1.06%	1.03%
TIME IN SERVICE		
< 1 Year	10.20%	11.12%
1-2 Years	12.34%	13.02%
3-5 Years	26.41%	27.96%
6-10 Years	20.78%	20.29%
11+ Years	29.20%	26.57%
Unknown	1.06%	1.03%

Table E. 1991 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=75,329)	No HRA (N=735,861)
SEX		
Male	87.32%	87.59%
Female	11.57%	11.38%
Unknown	1.12%	1.03%
AGE		
<21	12.43%	12.88%
21-24	25.48%	27.97%
25-30	27.18%	26.38%
31-35	15.36%	14.57%
36-40	10.10%	10.07%
41-45	5.60%	5.09%
46-99	2.63%	1.90%
Unknown	1.22%	1.15%
RACIAL/ETHNIC GROUP		
White	71.96%	61.65%
Black	19.09%	28.57%
Hispanic	3.89%	4.01%
Other	2.72%	2.35%
Asian/Pacific Island	0.90%	1.75%
Indian/Alaskan	0.27%	0.57%
Unknown	1.18%	1.11%
DEPENDENTS		
Member + 1 dependent	16.75%	17.20%
Member + 2 or more	38.46%	40.50%
Member only	43.43%	41.06%
Unknown	1.36%	1.25%
MARITAL STATUS		
Married	50.68%	53.03%
Single	40.54%	38.61%
No longer married	3.56%	3.97%
Unknown	5.22%	4.39%
EDUCATION		
High School/Alternate Education	73.72%	80.25%
College	24.01%	17.81%
Unknown	2.27%	1.94%
GRADE		
Enlisted	79.77%	85.92%
Officer	16.72%	11.12%
Warrant Officer	2.41%	1.96%
Unknown	1.10%	1.01%
TIME IN SERVICE		
< 1 Year	9.51%	8.82%
1-2 Years	11.42%	11.37%
3-5 Years	26.68%	29.73%
6-10 Years	21.30%	20.99%
11+ Years	29.99%	28.08%
Unknown	1.10%	1.01%

Table F. 1992 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=100,186)	No HRA (N=672,774)
SEX		
Male	87.01%	87.19%
Female	12.00%	11.77%
Unknown	0.99%	1.04%
AGE		
<21	11.09%	11.85%
21-24	25.58%	27.98%
25-30	26.20%	25.91%
31-35	16.64%	14.93%
36-40	11.08%	10.82%
41-45	5.54%	5.25%
46-99	2.73%	2.12%
Unknown	1.14%	1.14%
RACIAL/ETHNIC GROUP		
White	69.67%	60.92%
Black	20.65%	28.84%
Hispanic	4.33%	4.25%
Other	3.04%	2.48%
Asian/Pacific Island	1.03%	1.90%
Indian/Alaskan	0.30%	0.59%
Unknown	0.98%	1.02%
DEPENDENTS		
Member + 1 dependent	16.79%	17.25%
Member + 2 or more	40.12%	41.72%
Member only	42.07%	39.99%
Unknown	1.02%	1.04%
MARITAL STATUS		
Married	53.43%	51.50%
Single	38.98%	37.44%
Unknown	3.75%	6.91%
No longer married	3.84%	4.15%
EDUCATION		
High School/Alternate Education	73.40%	79.79%
College	24.50%	18.33%
Unknown	2.10%	1.88%
GRADE		
Enlisted	80.06%	85.81%
Officer	16.68%	11.28%
Warrant Officer	2.32%	1.93%
Unknown	0.94%	0.99%
TIME IN SERVICE		
< 1 Year	10.52%	10.64%
1-2 Years	9.65%	9.14%
3-5 Years	26.31%	29.00%
6-10 Years	21.12%	20.95%
11+ Years	31.47%	29.30%
Unknown	0.94%	0.99%

Table G. 1993 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=72,734)	No HRA (N=602,281)
SEX		
Male	86.42%	86.37%
Female	12.32%	12.39%
Unknown	1.26%	1.23%
AGE		
<21	11.41%	12.02%
21-24	26.71%	28.07%
25-30	24.93%	25.38%
31-35	15.71%	14.32%
36-40	11.31%	11.13%
41-45	5.57%	5.37%
46-99	2.96%	2.31%
Unknown	1.39%	1.39%
RACIAL/ETHNIC GROUP		
White	72.40%	60.89%
Black	18.38%	28.01%
Hispanic	3.84%	4.65%
Other	2.75%	2.60%
Asian/Pacific Island	1.12%	2.03%
Indian/Alaskan	0.28%	0.59%
Unknown	1.23%	1.23%
DEPENDENTS		
Member + 1 dependent	16.89%	17.46%
Member + 2 or more	39.26%	41.59%
Member only	42.33%	39.54%
Unknown	1.52%	1.40%
MARITAL STATUS		
Married	55.37%	57.39%
Single	39.42%	36.96%
No longer married	3.81%	4.20%
Unknown	1.40%	1.45%
EDUCATION		
High School/Alternate Education	71.62%	78.19%
College	25.71%	19.49%
Unknown	2.67%	2.32%
GRADE		
Enlisted	78.92%	84.86%
Officer	17.36%	11.86%
Warrant Officer	2.57%	2.11%
Unknown	1.15%	1.17%
TIME IN SERVICE		
< 1 Year	10.41%	10.26%
1-2 Years	11.90%	11.68%
3-5 Years	25.93%	27.09%
6-10 Years	19.35%	20.32%
11+ Years	31.25%	29.46%
Unknown	1.15%	1.17%

Table H. 1994 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=67,337)	No HRA (N=565,006)
SEX		
Male	85.96%	85.88%
Female	12.79%	12.91%
Unknown	1.25%	1.21%
AGE		
<21	10.56%	11.37%
21-24	26.79%	27.39%
25-30	24.95%	25.84%
31-35	16.06%	14.80%
36-40	11.89%	11.62%
41-45	5.55%	5.38%
46-99	2.89%	2.32%
Unknown	1.29%	1.26%
RACIAL/ETHNIC GROUP		
White	71.90%	60.78%
Black	18.24%	27.62%
Hispanic	4.15%	4.89%
Other	2.98%	2.78%
Asian/Pacific Island	1.24%	2.14%
Indian/Alaskan	0.28%	0.60%
Unknown	1.21%	1.19%
DEPENDENTS		
Member + 1 dependent	17.26%	17.89%
Member + 2 or more	39.84%	42.39%
Member only	41.71%	38.53%
Unknown	1.19%	1.19%
MARITAL STATUS		
Married	56.38%	58.58%
Single	38.31%	35.72%
No longer married	3.89%	4.32%
Unknown	1.43%	1.37%
EDUCATION		
High School/Alternate Education	71.13%	77.45%
College	26.24%	20.23%
Unknown	2.63%	2.32%
GRADE		
Enlisted	78.95%	84.70%
Officer	17.35%	12.08%
Warrant Officer	2.63%	2.13%
Unknown	1.07%	1.08%
TIME IN SERVICE		
< 1 Year	9.76%	9.59%
1-2 Years	11.32%	11.01%
3-5 Years	26.39%	26.46%
6-10 Years	19.51%	21.41%
11+ Years	31.95%	30.45%
Unknown	1.07%	1.08%

Table I. 1995 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=64,481)	No HRA (N=529,984)
SEX		
Male	85.58%	85.55%
Female	13.18%	13.29%
Unknown	1.24%	1.16%
AGE		
<21	10.33%	10.66%
21-24	25.83%	26.56%
25-30	25.76%	26.72%
31-35	16.19%	15.29%
36-40	12.08%	11.80%
41-45	5.57%	5.39%
46-99	3.00%	2.41%
Unknown	1.25%	1.17%
RACIAL/ETHNIC GROUP		
White	71.28%	60.40%
Black	18.17%	27.27%
Hispanic	4.45%	5.21%
Other	3.25%	3.02%
Asian/Pacific Island	1.32%	2.28%
Indian/Alaskan	0.27%	0.65%
Unknown	1.25%	1.17%
DEPENDENTS		
Member + 1 dependent	17.54%	17.99%
Member + 2 or more	39.69%	42.56%
Member only	41.57%	38.30%
Unknown	1.20%	1.15%
MARITAL STATUS		
Married	56.31%	58.72%
Single	38.36%	35.61%
No longer married	3.96%	4.39%
Unknown	1.36%	1.28%
EDUCATION		
High School/Alternate Education	69.99%	76.19%
College	27.52%	21.53%
Unknown	2.49%	2.28%
GRADE		
Enlisted	78.79%	84.36%
Officer	17.45%	12.37%
Warrant Officer	2.69%	2.22%
Unknown	1.07%	1.04%
TIME IN SERVICE		
< 1 Year	10.01%	9.57%
1-2 Years	9.92%	9.78%
3-5 Years	26.49%	26.19%
6-10 Years	20.19%	22.54%
11+ Years	32.33%	30.88%
Unknown	1.07%	1.04%

Table J. 1996 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=54,691)	No HRA (N=520,720)
SEX		
Male	84.34%	84.39%
Female	13.97%	14.01%
Unknown	1.69%	1.60%
AGE		
<21	11.27%	11.97%
21-24	24.70%	25.13%
25-30	26.35%	27.21%
31-35	15.94%	15.30%
36-40	11.65%	11.22%
41-45	5.45%	5.17%
46-99	2.93%	2.38%
Unknown	1.72%	1.62%
RACIAL/ETHNIC GROUP		
White	68.96%	59.82%
Black	18.52%	26.79%
Hispanic	5.40%	5.65%
Other	3.61%	3.04%
Asian/Pacific Island	1.47%	2.39%
Indian/Alaskan	0.30%	0.68%
Unknown	1.74%	1.63%
DEPENDENTS		
Member + 1 dependent	17.38%	17.77%
Member + 2 or more	38.42%	41.39%
Member only	42.50%	39.23%
Unknown	1.70%	1.60%
MARITAL STATUS		
Married	54.73%	57.21%
Single	39.23%	36.55%
No longer married	4.10%	4.45%
Unknown	1.94%	1.80%
EDUCATION		
High School/Alternate Education	65.07%	71.03%
College	27.27%	21.61%
Unknown	7.66%	7.35%
GRADE		
Enlisted	78.46%	83.72%
Officer	17.40%	12.59%
Warrant Officer	2.60%	2.21%
Unknown	1.54%	1.49%
TIME IN SERVICE		
< 1 Year	12.69%	12.30%
1-2 Years	9.94%	9.68%
3-5 Years	25.34%	25.01%
6-10 Years	19.38%	21.48%
11+ Years	31.11%	30.05%
Unknown	1.54%	1.49%

Table K. 1997 Demographic Comparisons of HRA Takers to HRA Non-Takers

	HRA (N=44,953)	No HRA (N=515,638)
SEX		
Male	84.12%	84.21%
Female	14.77%	14.77%
Unknown	1.12%	1.02%
AGE		
<21	12.53%	13.59%
21-24	23.82%	24.17%
25-30	26.90%	27.11%
31-35	15.49%	15.32%
36-40	11.90%	11.17%
41-45	5.31%	5.15%
46-99	2.89%	2.45%
Unknown	1.16%	1.05%
RACIAL/ETHNIC GROUP		
White	66.96%	59.77%
Black	19.24%	26.69%
Hispanic	6.77%	6.35%
Other	3.89%	2.95%
Asian/Pacific Island	1.66%	2.52%
Indian/Alaskan	0.34%	0.71%
Unknown	1.14%	1.01%
DEPENDENTS		
Member + 1 dependent	17.07%	17.46%
Member + 2 or more	37.98%	40.79%
Member only	43.82%	40.73%
Unknown	1.13%	1.02%
MARITAL STATUS		
Married	53.92%	56.27%
Single	40.70%	38.08%
No longer married	4.13%	4.52%
Unknown	1.25%	1.13%
EDUCATION		
High School/Alternate Education	69.13%	74.60%
College	27.07%	21.85%
Unknown	3.80%	3.55%
GRADE		
Enlisted	79.49%	84.20%
Officer	17.05%	12.71%
Warrant Officer	2.52%	2.22%
Unknown	0.94%	0.87%
TIME IN SERVICE		
< 1 Year	13.43%	13.08%
1-2 Years	12.15%	11.81%
3-5 Years	23.71%	23.36%
6-10 Years	19.52%	20.88%
11+ Years	30.24%	30.01%
Unknown	0.94%	0.87%

Appendix B. Figures

Figure A. Rank Distribution of HRA Takers 1987-1997

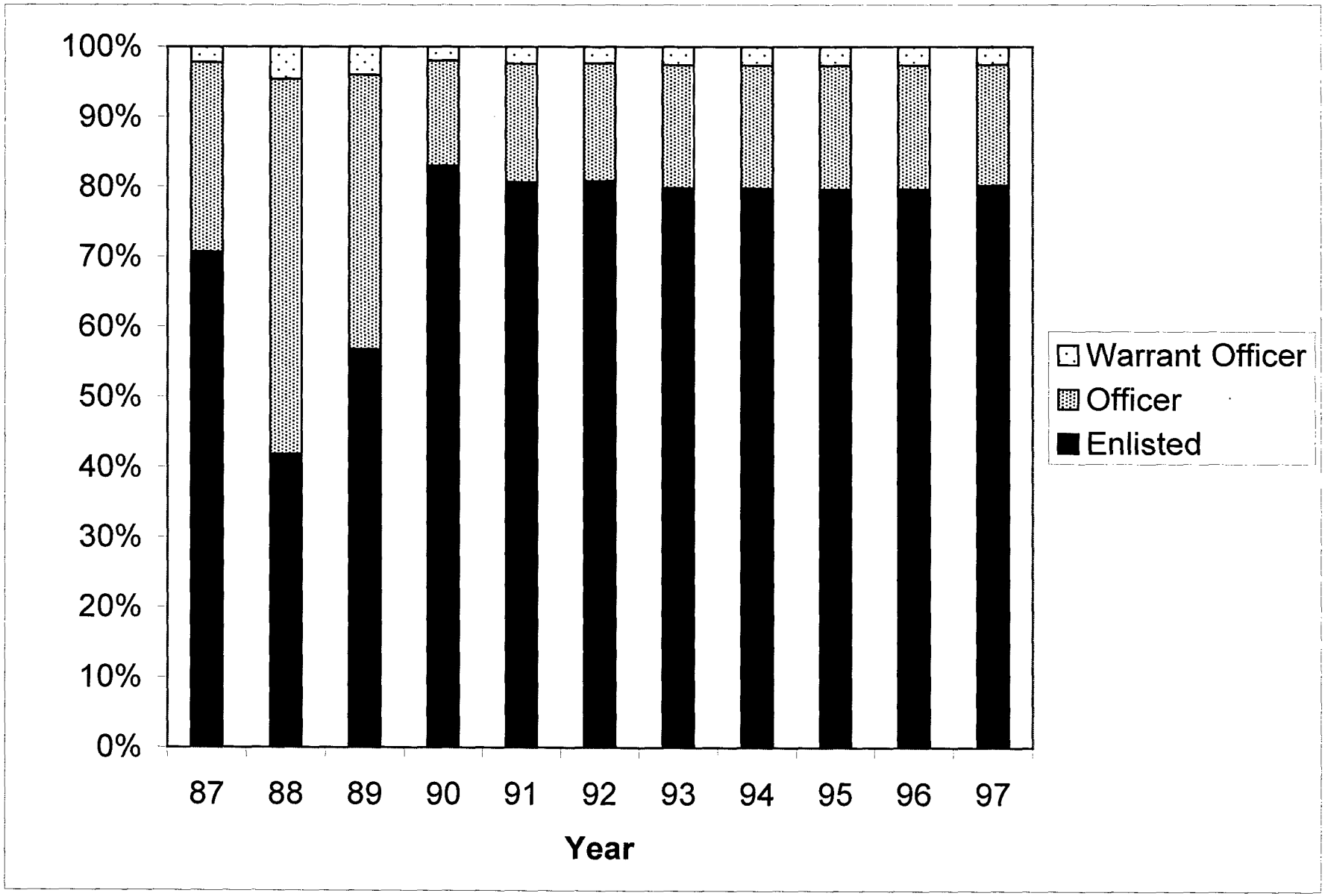


Figure B. Age Distribution of HRA Takers 1987-1997

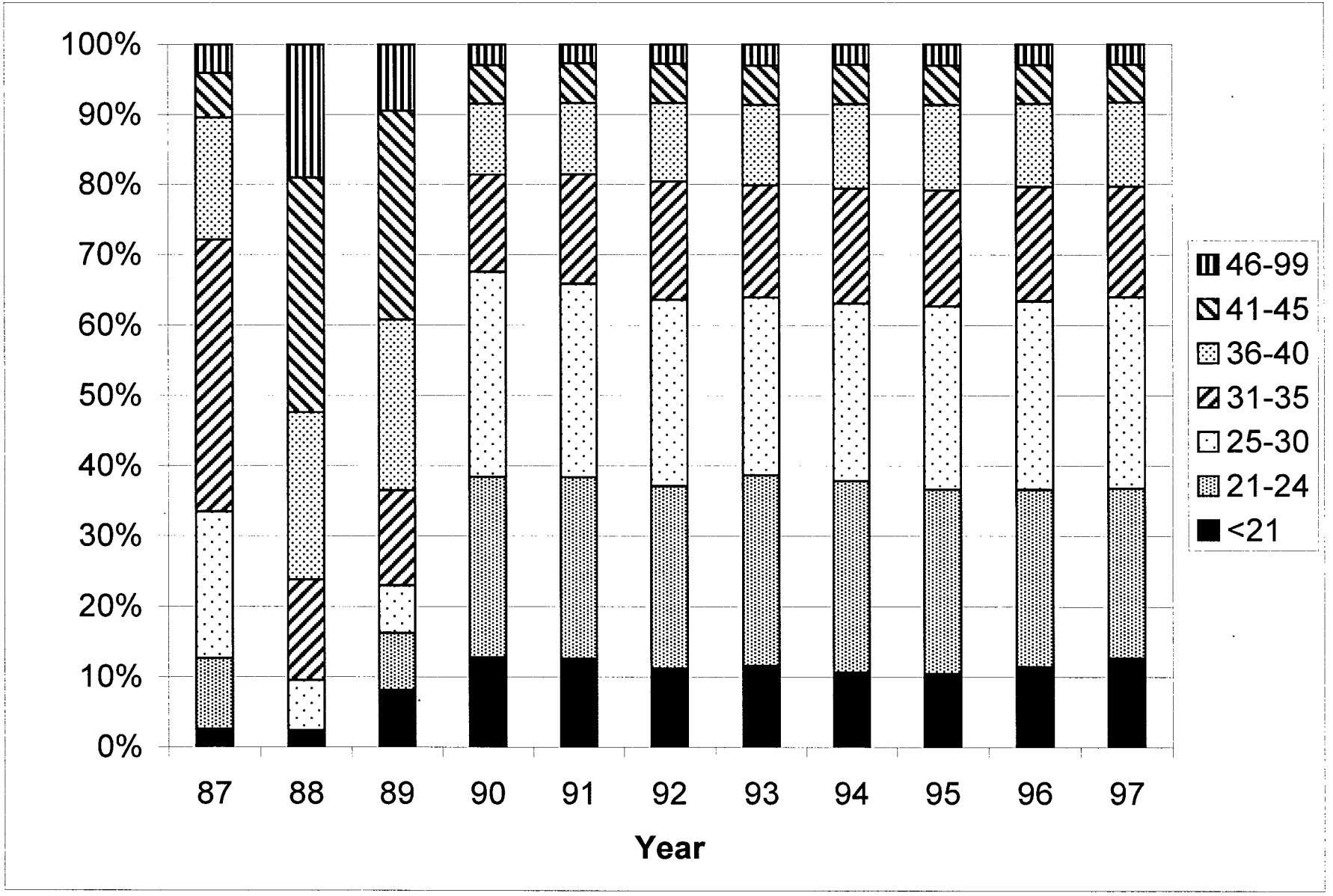


Figure C. Sex Distribution of HRA Takers 1987-1997

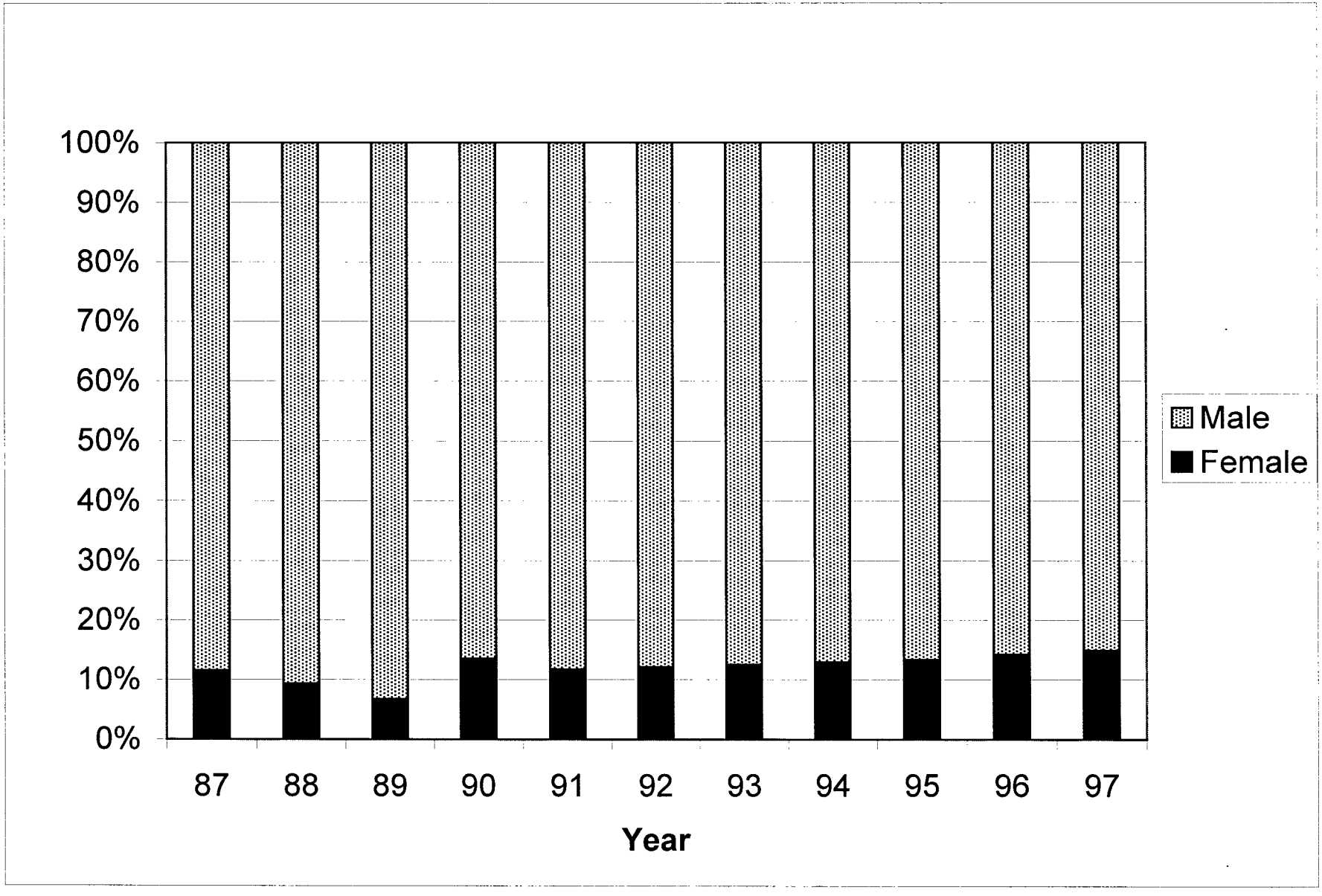
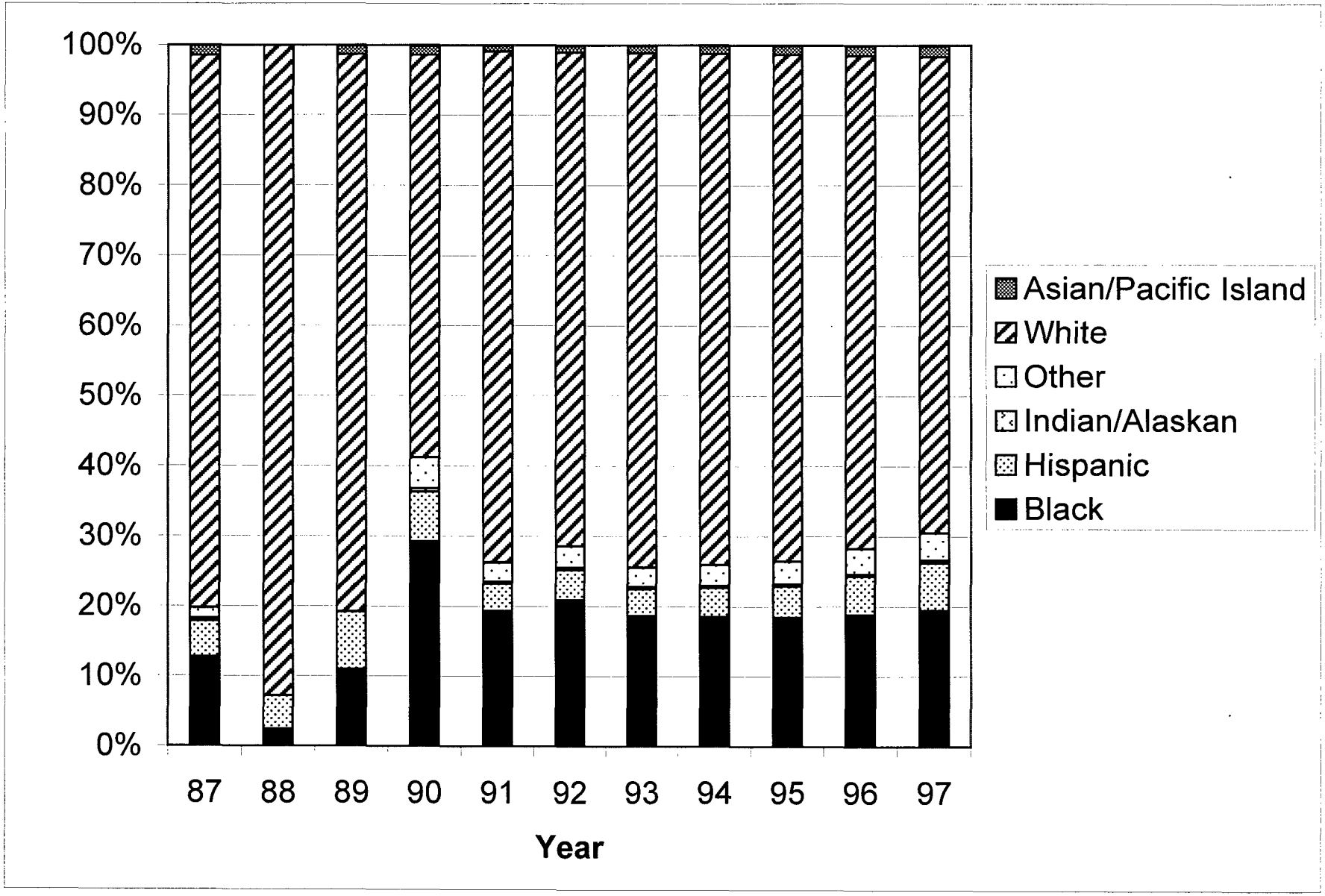


Figure D. Racial/Ethnic Group Distribution of HRA Takers 1987-1997



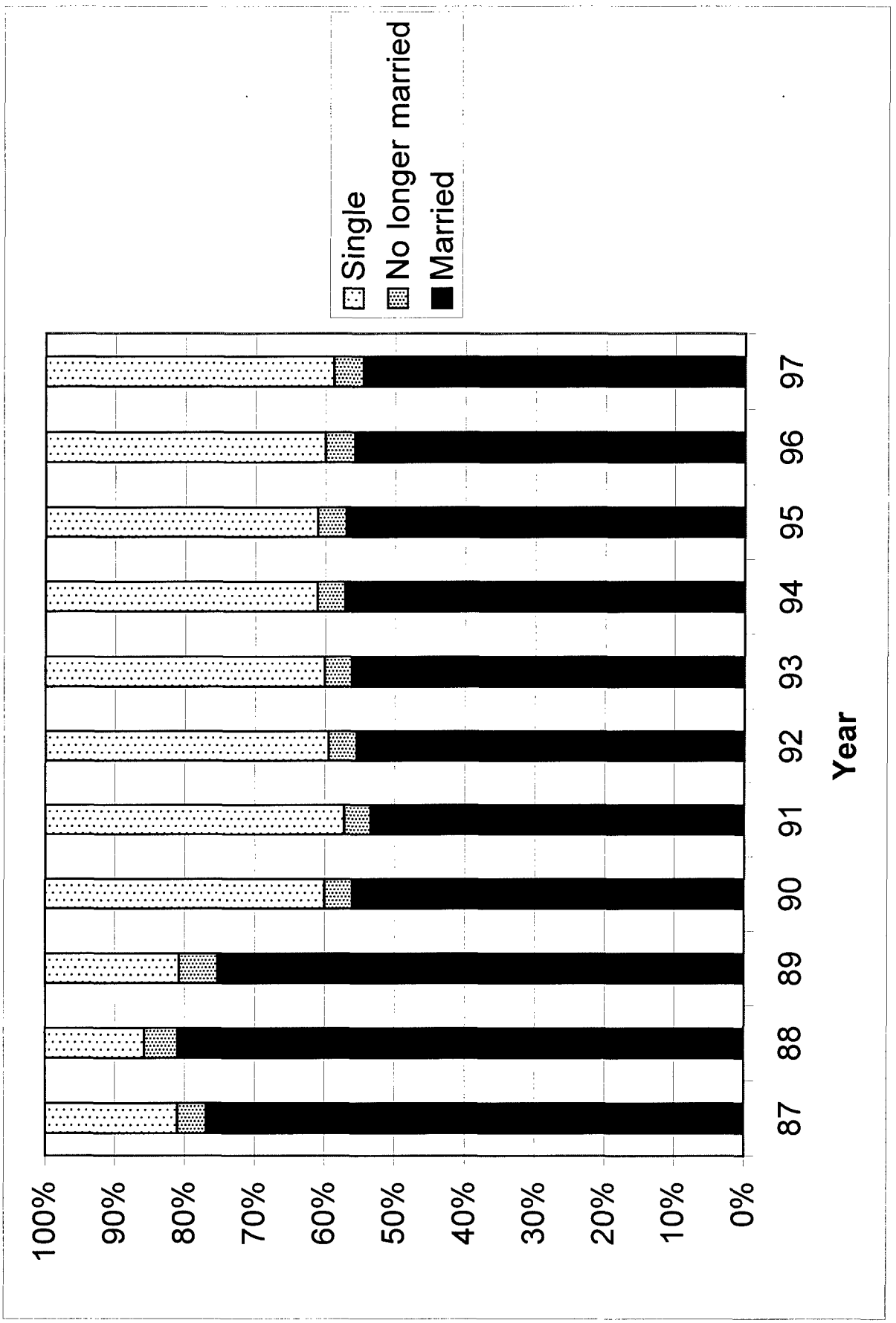


Figure E. Marital Status Distribution of HRA Takers 1987-1997

Figure F. Education Distribution of HRA Takers 1987-1997

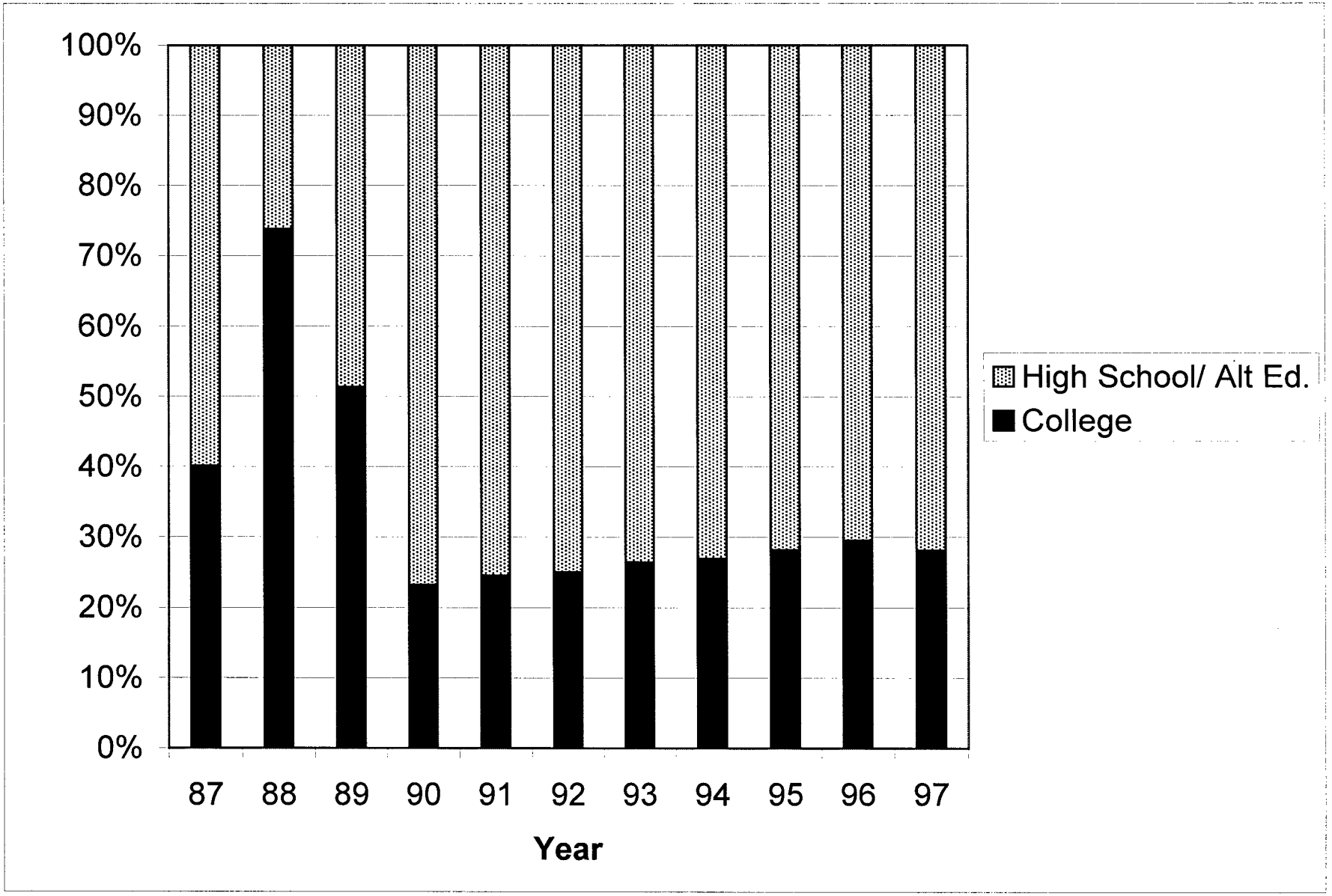
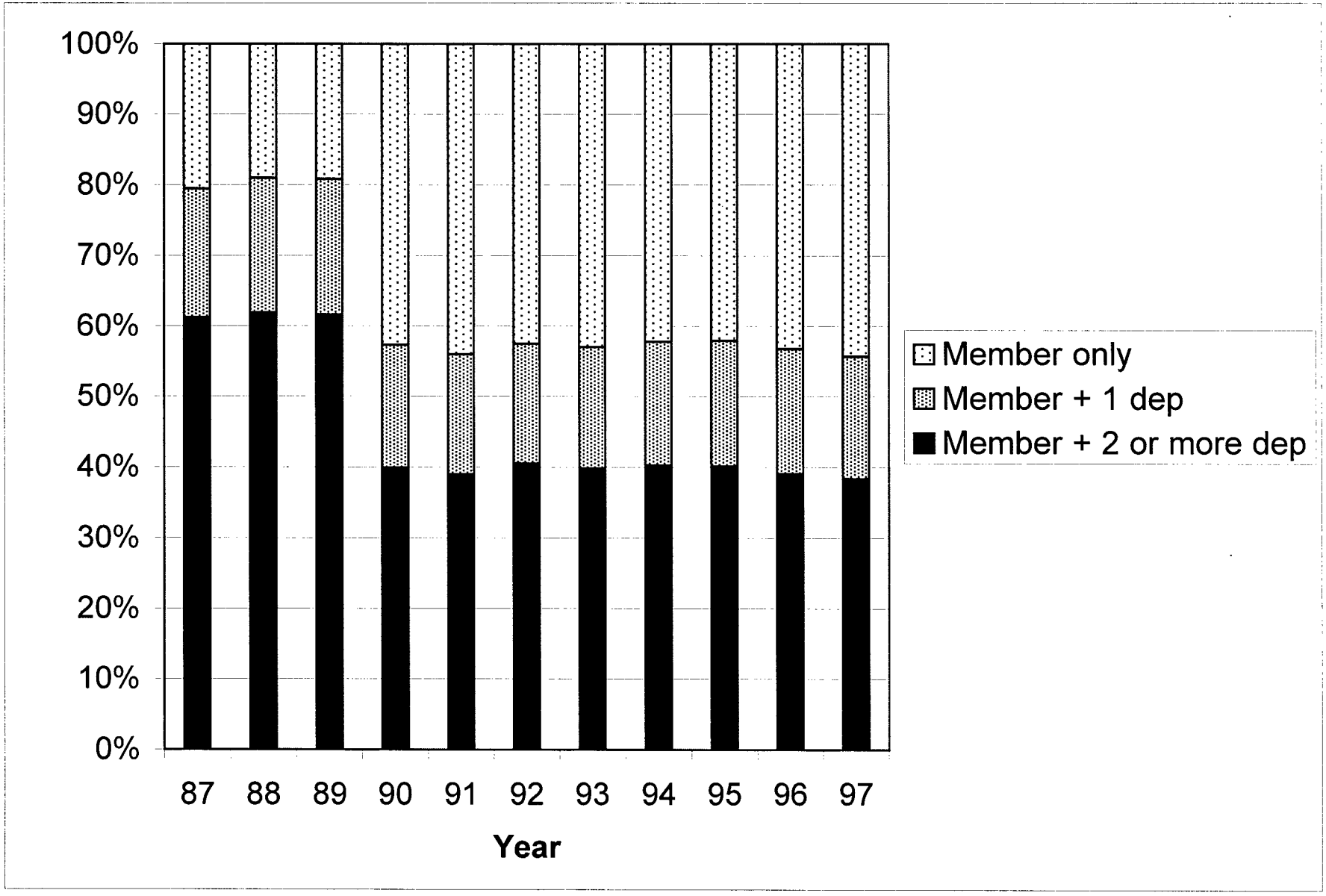


Figure G. Dependents Distribution of HRA Takers 1987-1997



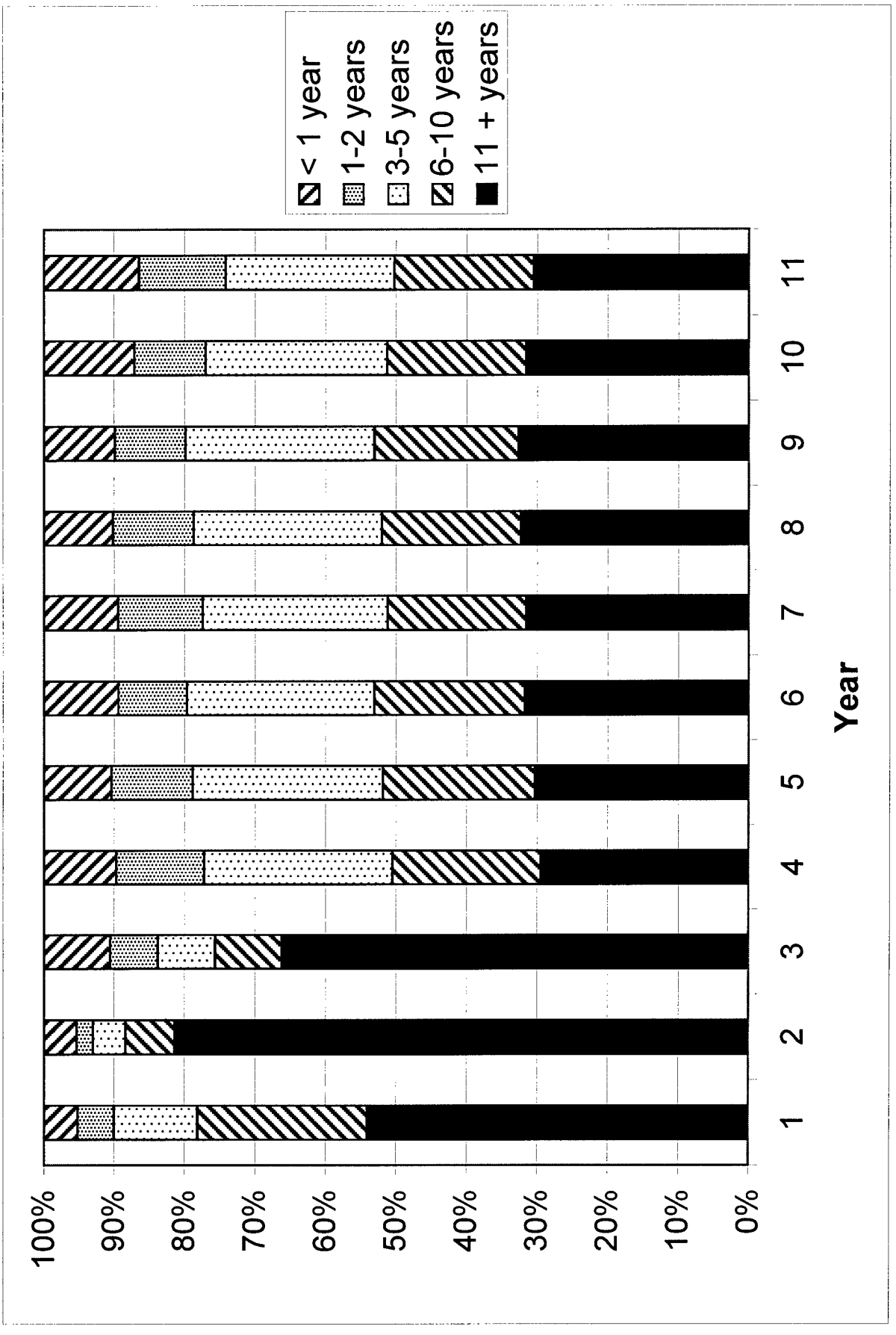


Figure H. Time in Service Distribution of HRA Takers 1987-1997

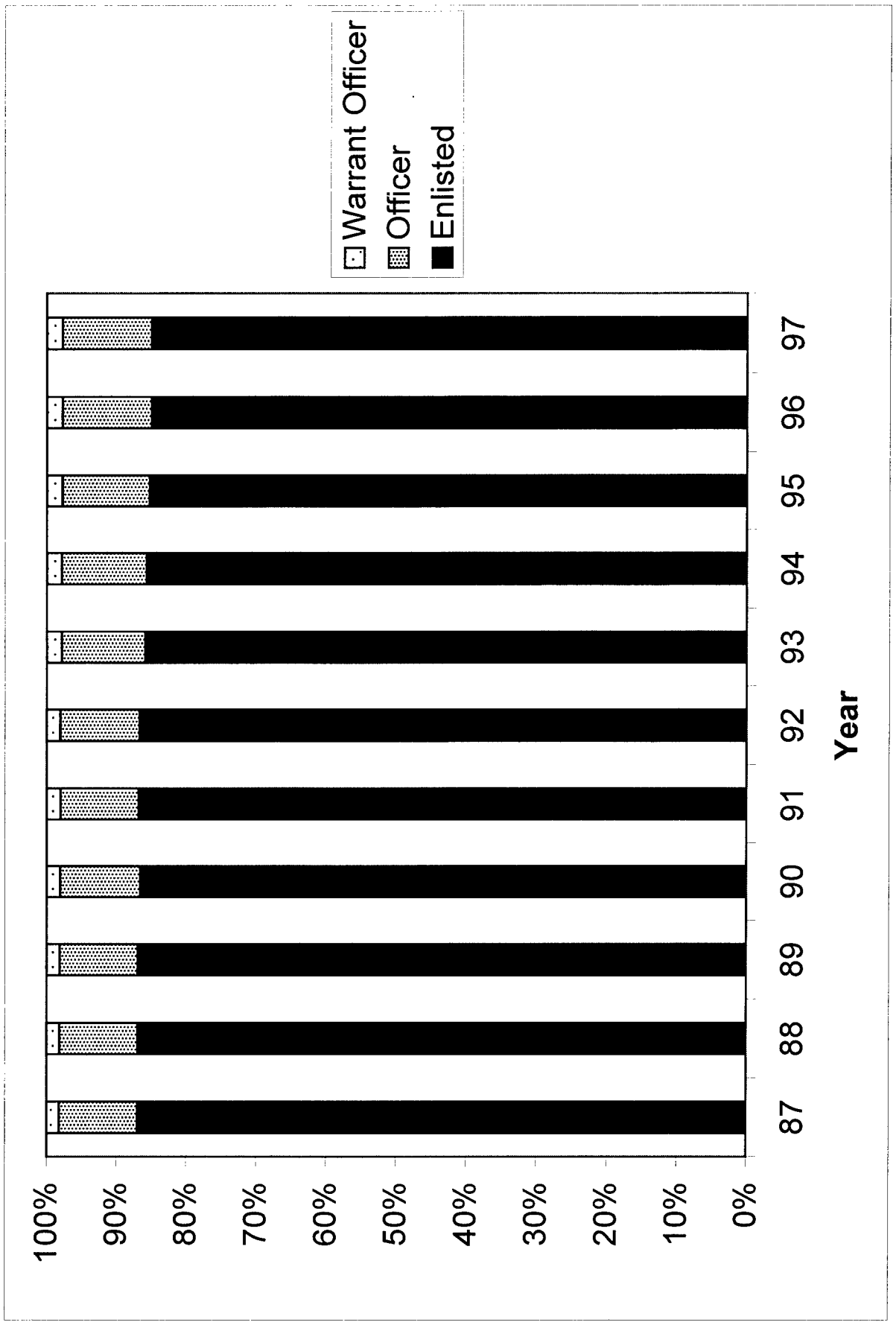


Figure I. Rank Distribution of HRA Non-Takers 1987-1997

Figure J. Age Distribution of HRA Non-Takers 1987-1997

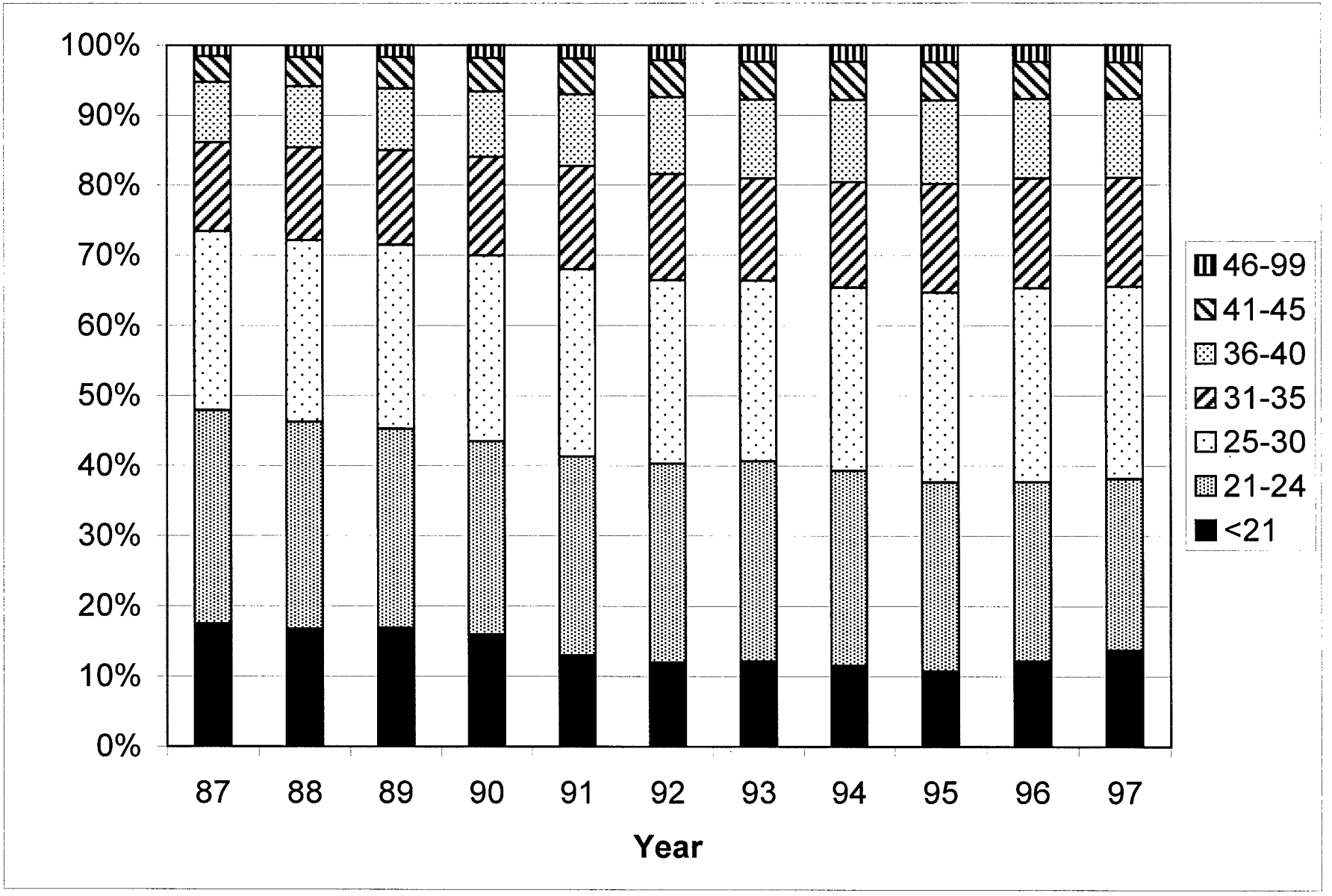


Figure K. Sex Distribution of HRA Non-Takers 1987-1997

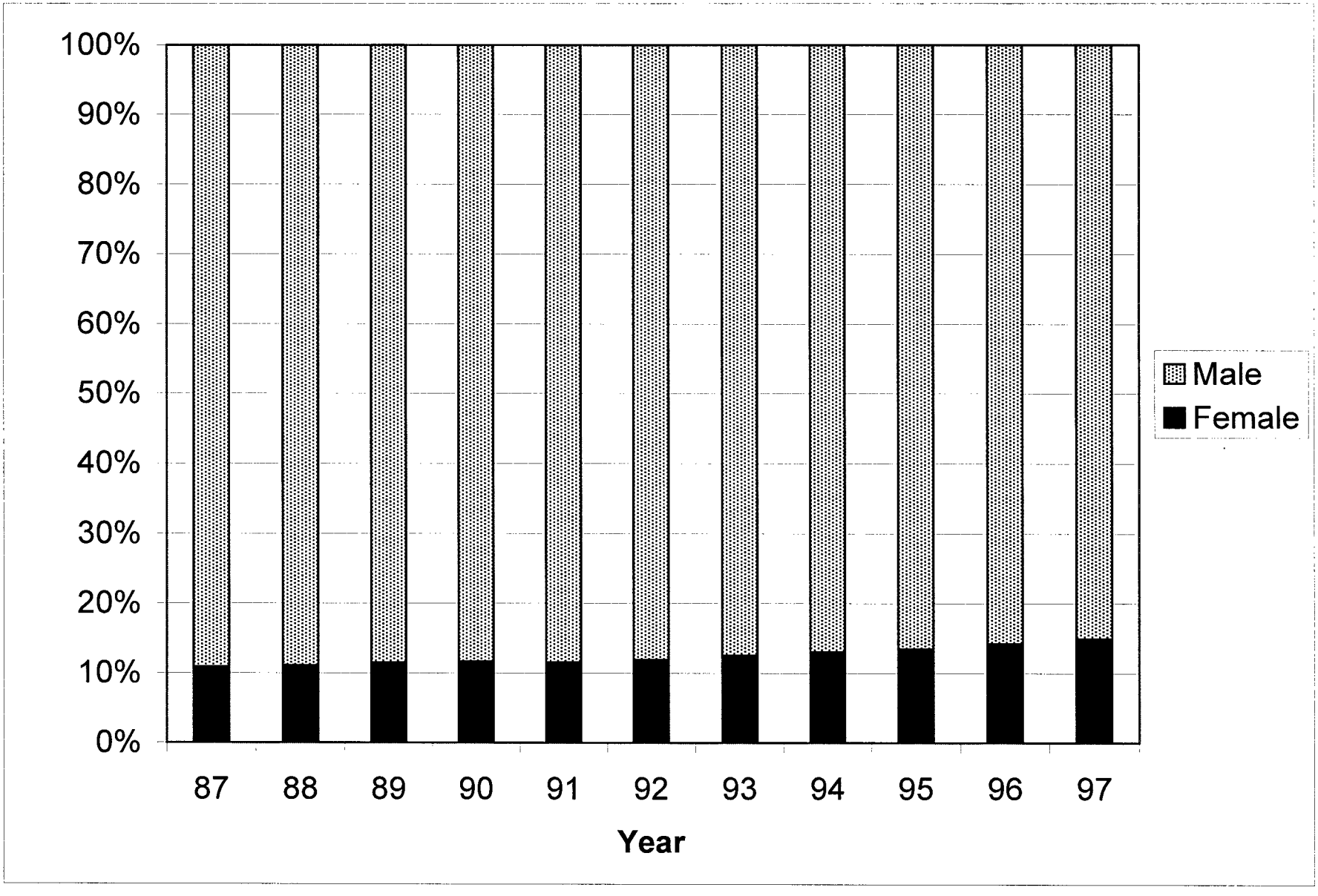


Figure L. Racial/Ethnic Group Distribution of HRA Non-Takers 1987-1997

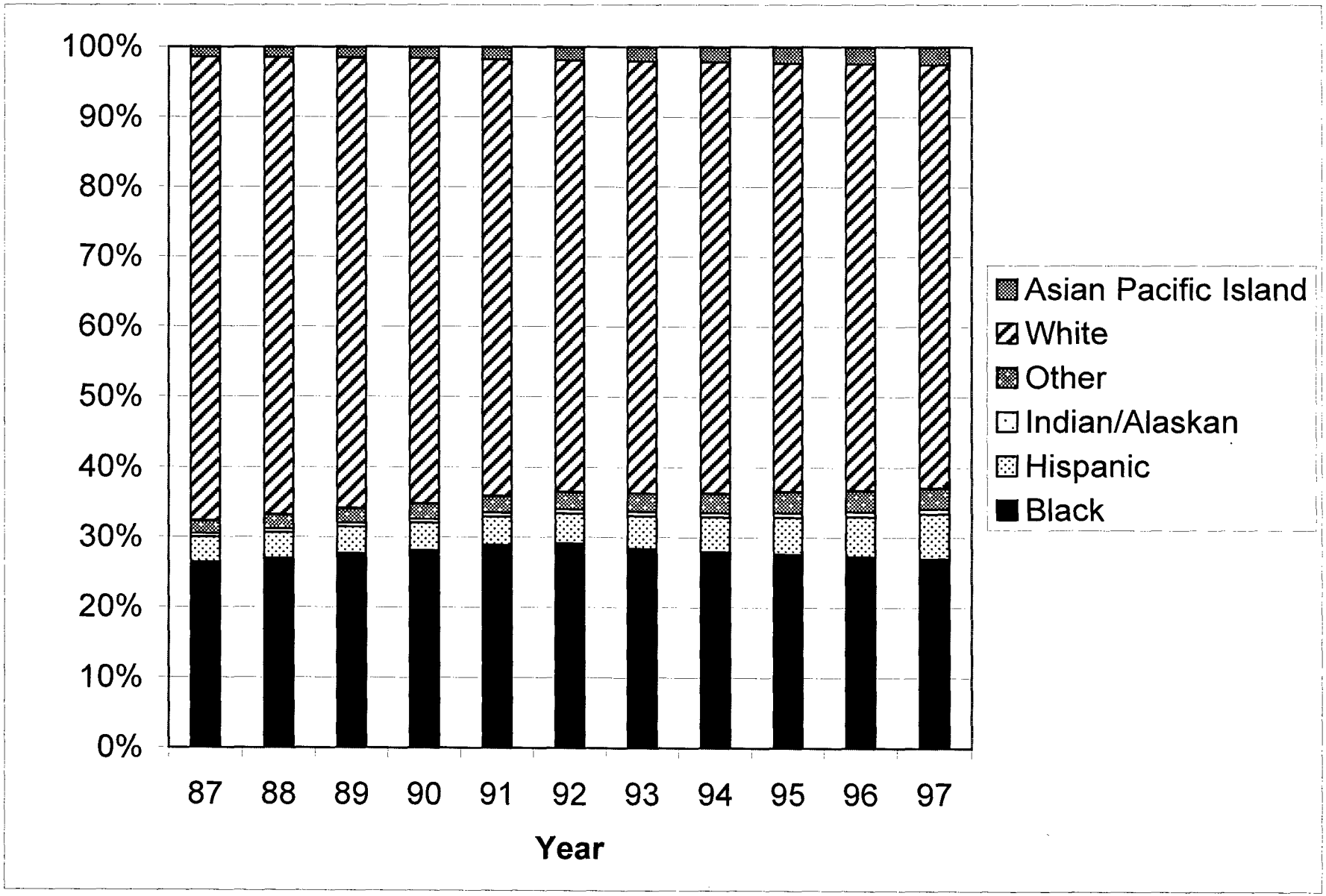


Figure M. Marital Status Distribution of HRA Non-Takers 1987-1997

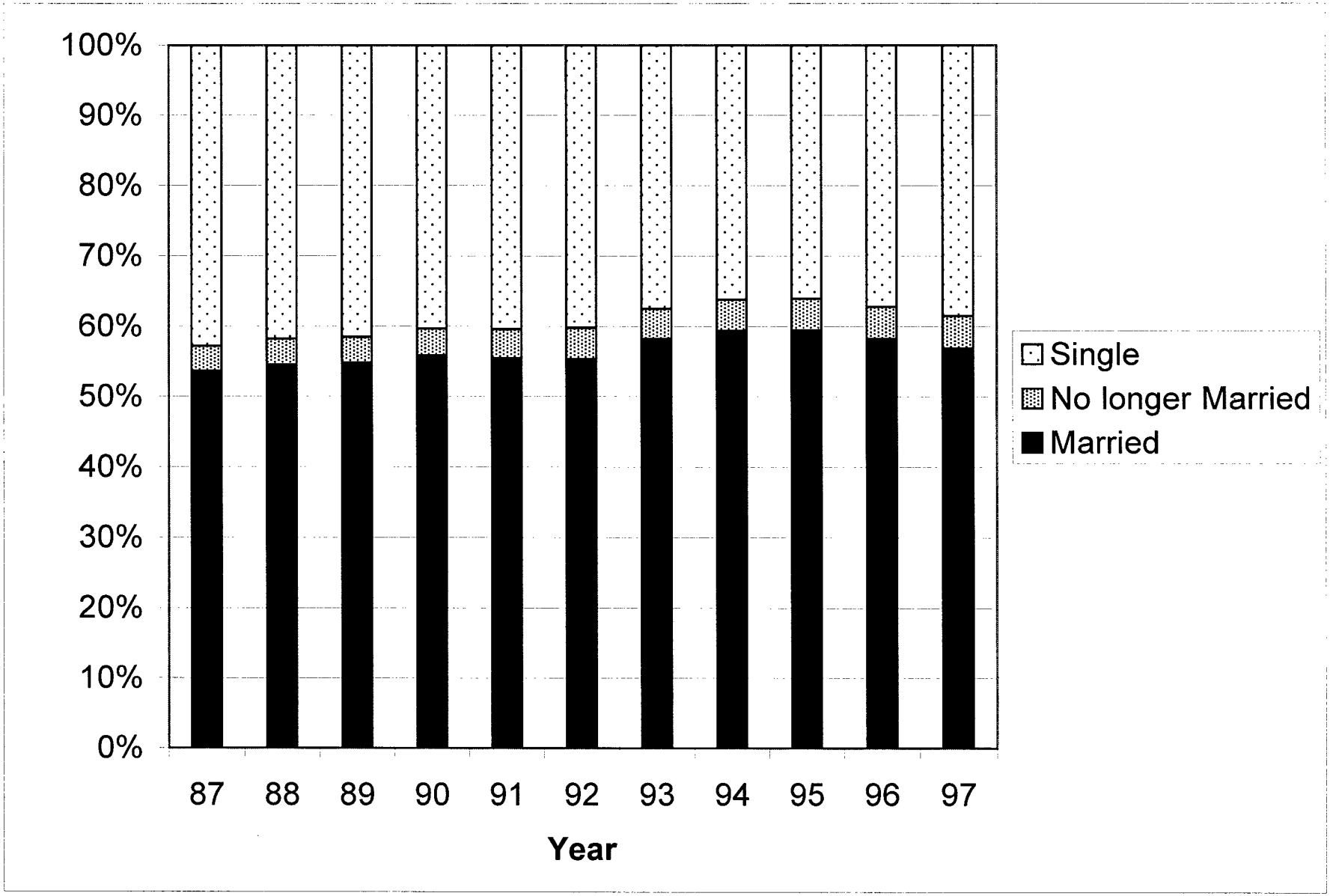


Figure N. Education Distribution of HRA Non-Takers

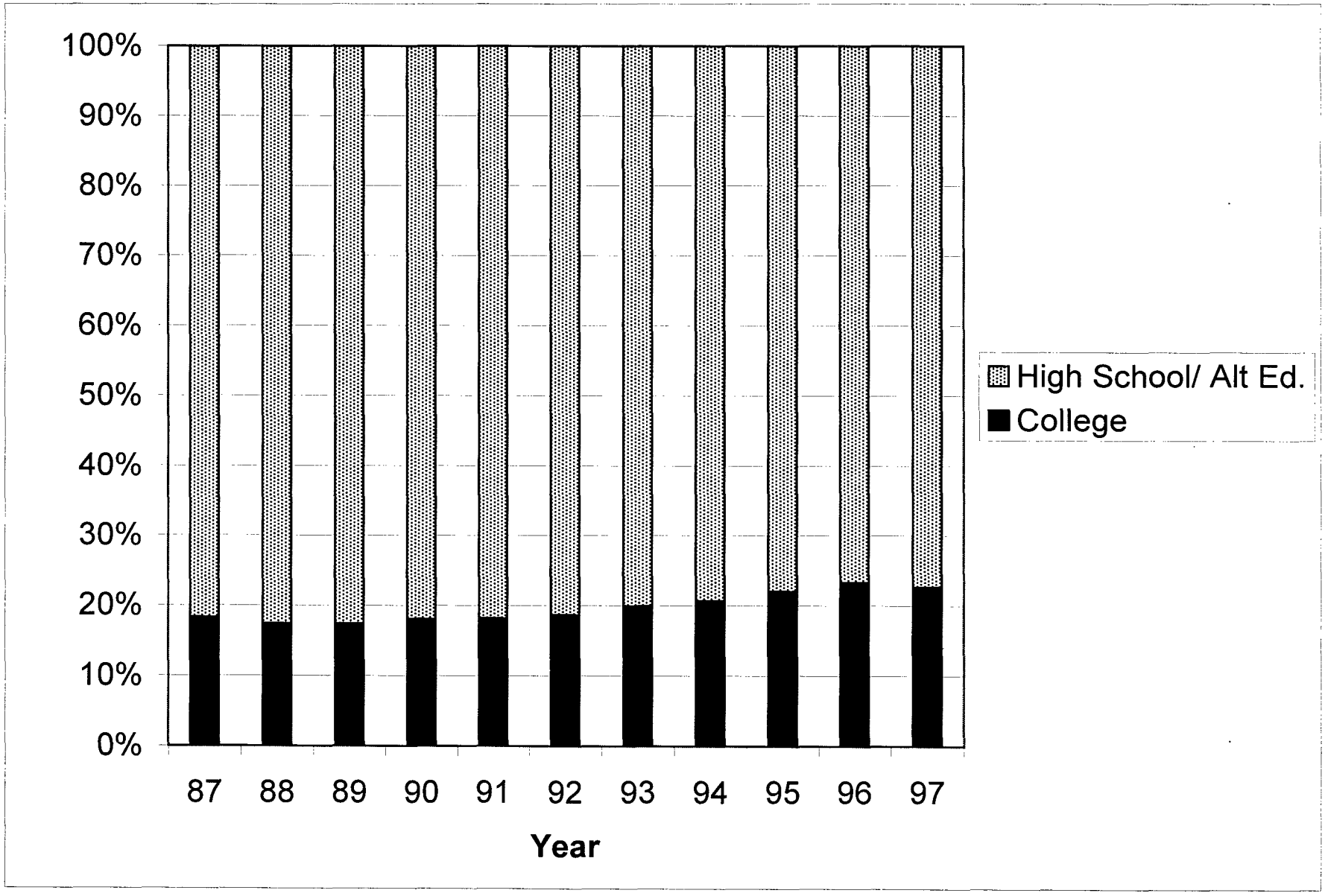
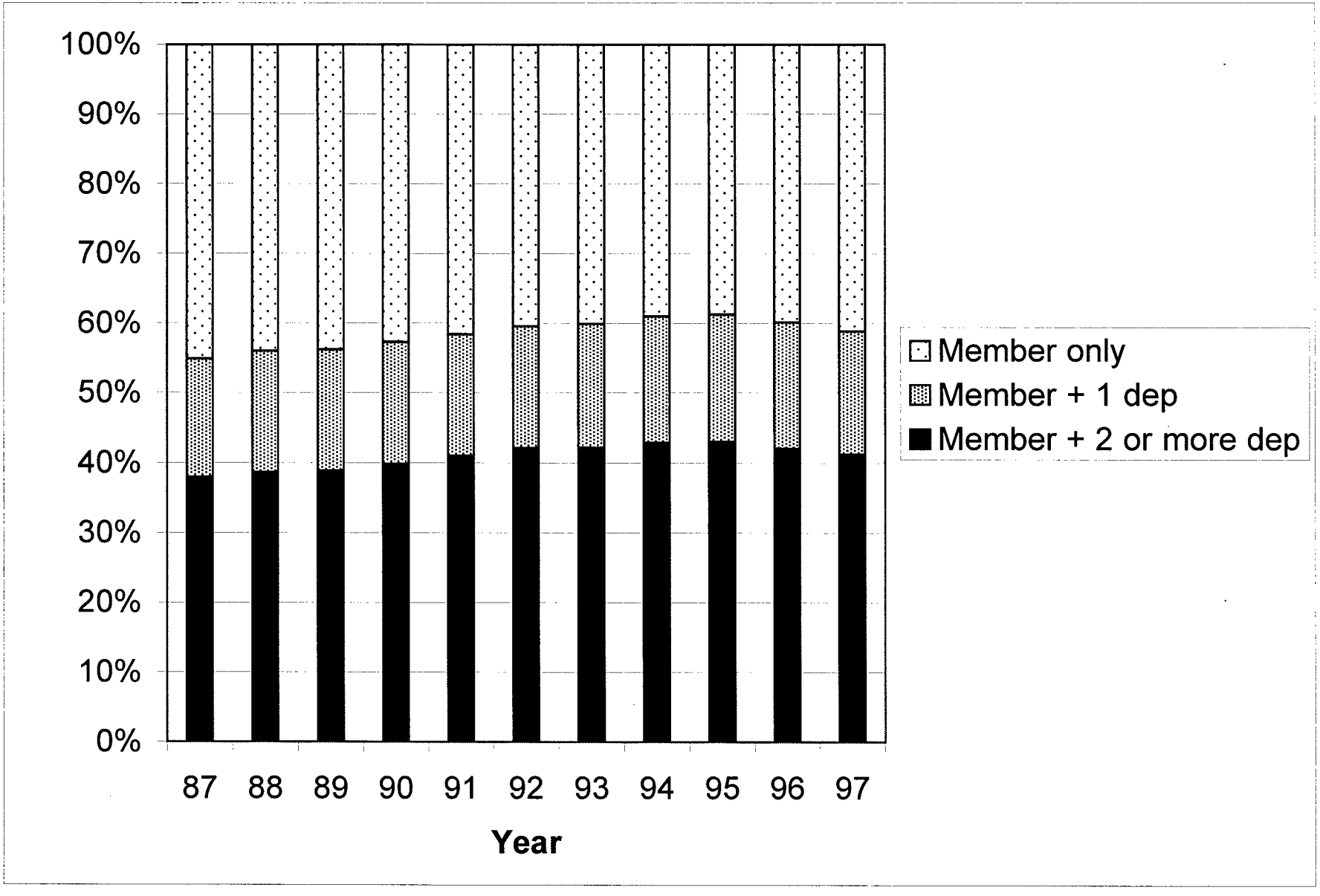


Figure O. Dependents Distribution of HRA Non-Takers 1987-1997



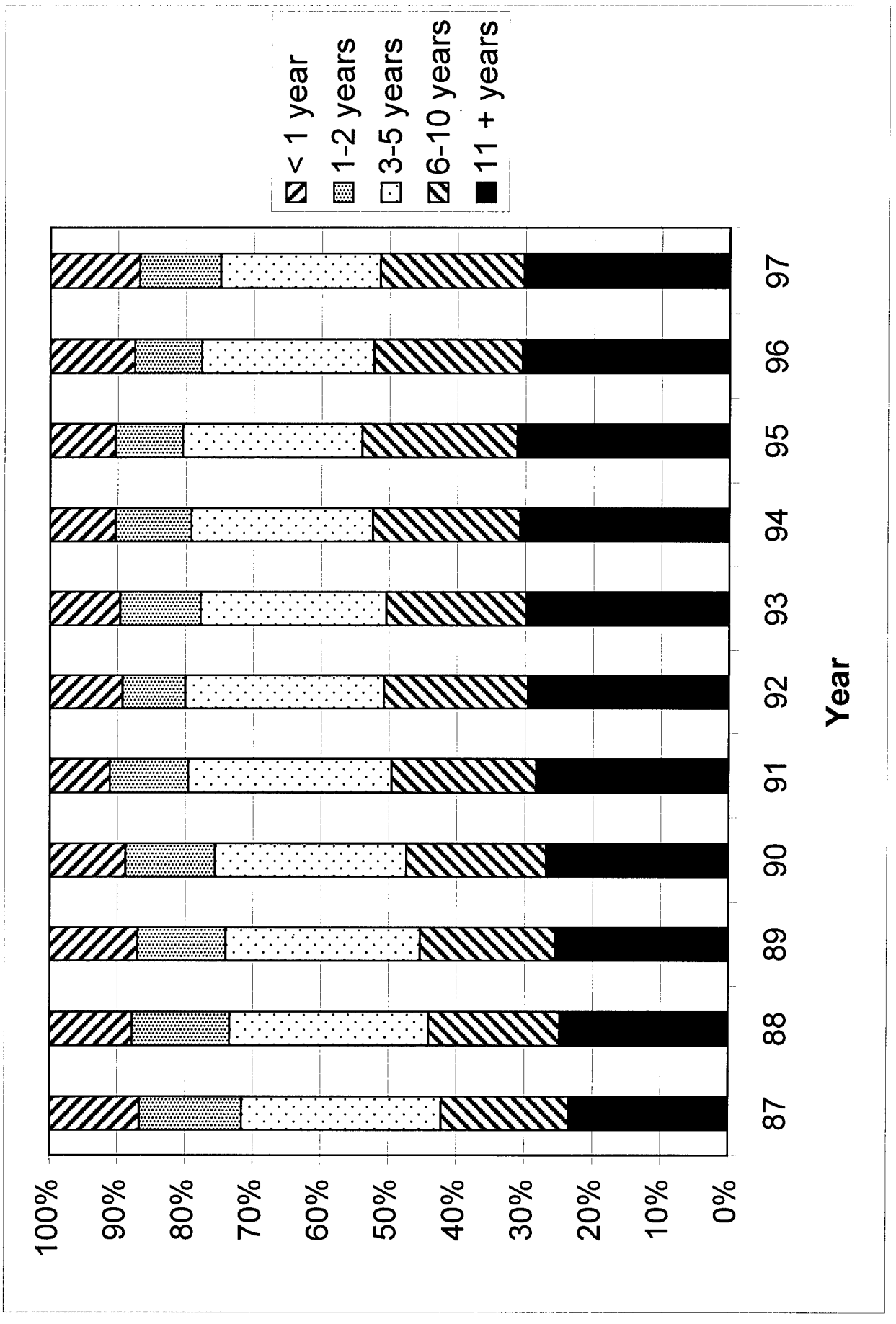


Figure P. Time in Service Distributioin of HRA Non-Takers 1987-1997

Appendix C. Development of a Working Definition of Gulf War Illness

Several researchers have documented the difficulty encountered in trying to define the myriad of somatic symptoms experienced by Gulf War veterans with a single diagnosed condition (4). There is sufficient evidence of an increased risk for a number of symptoms ranging from headaches, fatigue, numbness, and confusion to unrefreshing sleep among Gulf War era veterans who deployed to the Persian Gulf. Many of these symptoms do not allow for a definitive clinical diagnosis. In some cases there are enough symptoms of a particular variety to result in a diagnosis of a symptom-based condition such as fibromyalgia, chronic fatigue syndrome, and multiple chemical sensitivities. The determination of which diagnosis is made may depend less upon the constellation of symptoms presented and more on the particular medical training of the clinician making the diagnosis (14). The CCEP registry program resulted in a large group of self-selected veterans who were evaluated and provided a clinical diagnosis. This information may also be useful for identifying key problems faced by veterans of the Persian Gulf war. However, the fact that they were self-selected makes reliance on these outcomes alone ill-advised. Certainly it would limit the generalizability of findings.

The difficulties in constructing a single case definition do not diminish the importance and need for epidemiological studies to identify risk factors for experiencing these conditions or factors that might modify the experience of these conditions. Our team wrestled with this challenging task for several weeks. We reviewed a number of different approaches used by other researchers before developing an approach that we believe is defensible and which seems most likely to best incorporate health experiences of Gulf War veterans after the war. Most of the conditions more common to Gulf War veterans (aside from those "normally" seen in a large population, such as hypertension) seem to relate to ill-defined conditions or signs and symptoms (15). We decided to develop a definition comprising ill-defined conditions and symptoms. To be sure we erred on the side of being all-inclusive of possible Gulf War related, symptom-based conditions, we also included the diagnoses most commonly made among veterans registered with the CCEP program. We worked in small teams to go through every ICD-9-CM code to identify conditions which were primarily symptom based and/or ill-defined. Each team included a board-certified medical doctor. Uncertainty and disagreements were addressed by the entire team and discussed until group consensus reached. This effort resulted in the list shown below.

NOTE: The definition that follows is still being debated within our group and is likely to undergo further refinement. For example, there is still discussion regarding whether or not emotional (as well as somatic) symptom-based conditions should be included. This current working definition and effort should be considered proprietary and not reprinted for public review without express permission from Drs. Bell and Amoroso.

Non-Specific Diagnoses:

780 (4-digit)	These include general symptoms, fatigue not specified as chronic, other and unspecified sleep apnea, malaise and fatigue, other insomnia, fatigue, and memory loss
781-789 (3 digit)	These include headaches, sleep disturbance, rash, shortness of breath, abdominal pain, and weight loss

Other Headaches

346.0-346.9	Allergic, migraine, cluster
307.81	Psychalgia, tension headache

Depressive Disorders

311	depressive disorders, not elsewhere classifed
296.2	major depressive disorder
300.4	neurotic depression

PTSD and other psychiatric types of disorders

309 series	prolonged PTSD, etc.
300.5	psychogenic (neurasthenia-psycholgenic asthenia and general fatigue)

Pain in Internal Organs

789.0	abdominal; other symptoms involving abdomen and pelvis
786.5 (786.5-786.52)	chest, unspecified chest pain precordial pain, and painful respiration
788.9	Bladder and other symptoms involving urinary system
536.8	Gastric (e.g., dyspepsia and other specified disorders of function of the stomach ache)
530.81	GERD
788.0	Other urinary tract related pain

Pain in Musculoskeletal System (NOS)

729.0-729.9	Pain in extremities including foot, hand... Also includes other disorders of sot tissues such as rheumatism, unspecified fibrositis, myalgia and myositis, unspecified neuralgia and radiculitis.
724.0-724.9	Pain in back and other and unspecified disorders of the back. Includes spinal stenosis other than cervical region; sciatica; thoracic or lumbosacral neuritis or radiculitis unspecified; backache, unspecified; disorders of the sacrum, coccyx or other symptoms referable to the back; lumbago
723.0 – 723.9	Pain in neck area including spinal stenosis in cervical region; cervicalgia; cervicocranial syndrome; panniculitis specified as affecting neck; ossification of posterior longitudinal ligament in cervical region; other syndromes affecting cervical region, unspecified
719.4 (all 5 digit)	Joint pain—including pain in multiple sites and pain in joint involving the lower leg
715.9	osteoarthrosis unspecified
524.60-524.69	TMJ and related unspecified disorders
526.9	Jaw, unspecified

Other Pain

307.8	Psychogenic pain including tension headaches, other psychogenic pain, site unspecified.

Asthma

493.0 – 493.9	asthma unspecified; extrinsic asthma; intrinsic asthma; chronic obstructive asthma

Irritable Colon

564.1	irritable colon
306.4	gastrointestinal portion of physiological malfunction arising from mental factors (psychogenic)
564.8	small intestine (other specified functional disorders of intestine under functional digestive disorders not elsewhere classified)

Allergic Rhinitis

477.9	Allergic rhinitis

Other Symptoms

692.0 – 692.9, 782.1	dermatitis; other unspecified skin rashes
558.9	Diarrhea
704.0	hair loss
523.8	bleeding gums
783.2	weight loss

Appendix D. Demographic, Physical, and Mental Health Factors Associated with Deployment of US Army Soldiers to the Persian Gulf

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Abstract

Hospitalizations among 675,626 active-duty Army soldiers, followed from 1980 through the Gulf War, and Health Risk Appraisal surveys for 374 soldiers, were used to evaluate *prewar* distress, health, and behavior of soldiers.

Deployers were less likely to have had any prewar hospitalizations, or a hospitalization for a condition commonly-reported among Gulf War veterans, or to report experiences of depression/suicidal ideation. Deployers reported greater satisfaction with life and relationships, but displayed greater tendencies toward risk-taking such as drunk-driving, speeding, and failure to wear safety-belts. Deployed veterans were more likely to receive hazardous-duty pay and to be hospitalized for an injury than non-deployed Gulf War era veterans.

If distress is a predictor of postwar morbidity it is likely due to experiences occurring during or postwar and not related to prewar exposures or health status. Postwar excess injury risk may be explained in part by a propensity for greater risk-taking, evident before, and persisting throughout the war.

INTRODUCTION

Nearly 700,000 American military personnel were deployed to the Persian Gulf between August of 1990 and April of 1991 in support of Operations Desert Shield/Desert Storm (ODS/DS), most of them Army soldiers. Soon after these soldiers began returning to the United States, reports of unexplained illnesses and nonspecific symptoms (later termed "Gulf War Illnesses") began to surface. After nearly 10 years of research and a great deal of media attention, the cause of these problems remains elusive.

One possible, though largely unexplored, explanation for the development of Gulf War-related illnesses is the potential that the process used to select soldiers for deployment resulted in a deployed group with intrinsic or acquired traits that predisposed them to Gulf War Illnesses. That is, perhaps prewar differences between those who deployed and those who did not deploy may explain in part the increased risk for certain conditions commonly reported among Gulf War veterans. At a minimum, the potential confounding influence of these differences deserves comprehensive evaluation in current research efforts.

The purpose of this paper is to describe prewar demographic, occupational, and physical and mental health status of active duty Army soldiers who deployed to the Persian Gulf; and to compare these characteristics to soldiers on active duty who did not deploy.

BACKGROUND

Studies of Gulf War veterans have focused principally on postwar health outcomes. Few studies have compared the prewar experiences, health habits, and general mental and physical health status of veterans. Most significantly, few studies have explored how factors predicting deployment may confound or contribute to soldiers' risk of developing Gulf War-related illnesses subsequent to service in the Gulf. Documenting differences between soldiers based on whether they deployed or not may improve understanding of post-deployment soldier health.

Differences in demographic variables, health behaviors, risk-taking behaviors, mental or physical health could influence a soldier's postwar health status. Such factors could affect the chance of selection for deployment (e.g., risk-taking habits), risk of future illness independent of deployment (e.g., cigarette smoking), risk for responding to the deployment experience with increased risk-taking behaviors (e.g., postwar increases in alcohol use as a coping response).

During ODS/DS, deployed soldiers did not experience significantly higher overall mortality rates than non-deployed Gulf War era veterans, or the US population at large with the exception of unintentional injury death (1). Similarly, a study of postwar mortality found that deployed Gulf War veterans were significantly more likely to die from accidents, such as motor-vehicle crashes, than their non-deployed counterparts, but not from illness-related deaths (2). This suggests either risk-taking differences between deployed and non-deployed soldiers during and after the war or increased exposure to hazards. Since a veteran's experiences during the war might contribute to the adoption of unhealthy risk-taking behaviors after the war, it is important to look for the presence of these behaviors prior to deployment. Otherwise we will not be able to discern whether the war caused increases in risk taking, or whether prewar tendencies to engage in risky behaviors were in fact responsible for deployment. Similarly, suggestions that stressors or distress following service in the Gulf may predict Gulf War Illnesses cannot be fully evaluated without exploration of mental health or experiences of stressors *prior* to deployment.

Studies published to date have primarily measured health outcomes among individuals assigned to one or more specialized military units, often relying on small samples (3-13), in groups of veterans seeking treatment for conditions they believed to be related to service in the Gulf (10, 14-16), or in veteran populations drawn from a particular geographic locale(7, 10, 17-22). Many studies relied heavily upon self-reports of symptoms and exposures, sometimes with little obvious efforts to validate the reports or the measurement instrument used (7, 9-13, 17-22). Pre-morbid data on the physical and mental health status of Gulf War veterans is severely limited. There have been few population-based surveys that have examined health-related trends across the entire Army, or that have been able to control for a large

enough number of demographic variables to adequately assess the issue of who gets selected to deploy. This has resulted in an incomplete and potentially biased picture of the functional health status of Army Gulf War veterans, and has prevented a cogent assessment of the extent to which *prewar* factors affect a soldier's risk of developing Gulf War-related illnesses.

This paper expands upon existing knowledge by examining a broader range of prewar health status measures for all Army soldiers on active duty during the war, followed over a longer continuous prewar time-period. Also, this paper focuses specifically on the Army; a group known to be disproportionately high users of care for Gulf War health concerns (23). This study includes prospectively gathered information on a variety of mental health and risk-taking behavior measures.

METHODS

Study Population

675,626 active-duty Army soldiers were followed from 1980 or entry to the Army if they entered after 1980, to the beginning of the ODS/DS (August 1990). To control for differences in exposure risk (potential for deployment) only soldiers who remained on active duty for the full duration of ODS/DS (i.e., active-duty subjects, for whom we had confirmed demographic information at three observation points, June 1990, December 1990, and June 1991) were included in the cohort. 160,812 soldiers were on active duty during some portion of ODS/DS period but not for the entire period, seven and a half percent of which (12,098) were deployed to the Gulf. Because these individuals did not have the same opportunity to be deployed and are likely to be different from those who remained on active duty the entire period, they were excluded from analyses.

A sub-analysis of 374 members of the study population who took an Army Health Risk Appraisal (HRA) was also conducted in order to assess differences in prewar risk taking, self-reported experiences of stressors, and feelings related to distress or depression.

The Data

The Total Army Injury and Health Outcomes Database (TAIHOD) (24, 25) was used to describe the study population's demographic, health, and behavioral characteristics. The TAIHOD joins key elements from multiple Department of Defense (DOD) administrative and health databases, linked at the individual soldier level by encrypted social security numbers. Components used in these analyses included demographic and occupational records, self-reported health behaviors and quality of life (Health Risk Appraisal (HRA) surveys), hospitalizations, and health evaluations from the Comprehensive Clinical Evaluation Program for Gulf War veterans (CCEP[1]). (24, 25)

The TAIHOD DMDC data are collected at six-month intervals, in June and in December of each year. Discharge ("loss") files are merged to these files to provide a complete occupational history for every active duty soldier. HRAs, officially implemented by the Army in 1987, but not administered in large numbers until 1991, have been administered to a subset of the Army during routine in-processing to new work assignments, as part of periodic physical examinations, physical fitness testing, or during walk-in visits at occupational or outpatient health clinics. Though the mechanism for administration of the HRA is not entirely random, analysis of the demographic composition of those who took an HRA and those who did not reveals few demographic differences between the two groups. Also, those taking the HRA were no more likely to have had a prior hospitalization than those who did not take an HRA, suggesting similar health status (data not shown).

[1] The CCEP was established in June 1994, upon the directive of the Department of Defense, in order to evaluate Gulf War veterans who were concerned about their health, and to facilitate treatment for the myriad of complaints and conditions experienced by Gulf War veterans.

Variables for Analysis

The main outcome measure for these analyses is deployment to the Persian Gulf. The DMDC Gulf War deployment file was used to determine if a soldier was deployed to the Gulf War theatre of operations. For this analysis, deployment was defined by being sent to the Gulf War theatre at anytime between August 1, 1990, and June 14, 1991.

Demographics: Demographic information included gender, age, race, education, marital status, number of dependents, rank, total active duty service, and occupation (DoD occupational code). Demographic data from the June 1990 DMDC files are used for most analyses. For logistic regression models of prewar annual hospitalization risks, demographic data from the first observation point in each year are used.

For ease of analysis and interpretation, age is grouped as <21, 21-25, 26-30, 31-35, 36-40, and >40 years of age. Racial or ethnic groups are described as white, black, Hispanic, Asian/Pacific Islander, Alaskan/Indian, and other. Education is coded as less than a high school degree, high school degree or equivalent (GED), some college, bachelor's degree, any graduate education, and other. Marital status is coded as single (never married), no longer married, married with spouse not on active duty, married with spouse on active duty but not deployed to the Gulf, or married with spouse on active duty and deployed to the Gulf. Dependent status was coded as member only, member with one dependent, or member with two or more dependents. Military rank is coded as junior enlisted (E1-E4), senior enlisted (E5-E9), warrant officers, junior officers (O1-O3), officers (O4-O5), and senior officers (O6-O11). Total time on active duty was calculated from entry into the service until June, 1990 and grouped as follows: <6 months, 6-12 months, 13-24 months, 25-60 months, 61-120 months, 121 months to 180 months, 181 months to 240 months, and greater than 240 months (over 20 years).

Some military soldiers receive hazardous duty pay as partial compensation for their occupational exposures. Hazardous duty pay is received by flight crew, parachutists, divers, those assigned to war zones (combat pay) or foreign duty, and those exposed to environmental stressors or experimental vaccines. Hazardous duty has been linked in prior research to increased risk of injury(26). For this study, hazardous duty pay was coded as: not-receiving hazardous duty pay, or receiving one type of hazardous duty pay only, or receiving two or more types of hazardous duty pay concurrently between January 1, 1990 and June 30, 1990. Thus, hazardous duty compensation received in this time period reflects exposures *prior* to ODS/DS.

Occupations were grouped using the Department of Defense (DoD) occupational codes[2]. DoD occupational codes are broad occupational categories comprised of similar Military Occupational Specialties (MOS). Occupational specialties available differ by rank and often by gender. The categories for enlisted personnel include infantry/gun crews, electrical equipment repair, communications/intelligence, health care, technical/allied specialists, support/administration, mechanical equipment repair, crafts workers, service/supply, and non-occupational. Warrant and commissioned officer categories include general officer/executive, tactical operations officer, intelligence officer, engineering and maintenance officer, scientists and professionals, health care officers, administrators, supply/procurement and allied officers, and non-occupational.

Health & Health Behaviors: The hospital and HRA components of the TAIHOD were used to document prewar health status. Hospitalizations were examined in three overlapping categories, any cause, injuries (ICD-9-CM 800-999), and conditions most commonly observed among Army Gulf War veterans evaluated for Gulf War related health concerns[3]. Though there is no clear consensus from the medical community

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[2] DoD 1312.1-I, Occupational Conversion Index. Enlisted/Officer/Civilian, March 1997

[3] Major depressive disorder, single episode (296.20), neurotic depression (300.4), tension headache (307.81), prolonged post traumatic stress disorder (309.81), depressive disorder, not elsewhere classified (311), migraine, unspecified (346.90), essential hypertension, unspecified (401.90), allergic rhinitis, cause unspecified (477.9), asthma, unspecified (493.90), esophageal reflux, without inflammation (530.81), irritable colon, not elsewhere specified (564.1), contact dermatitis and other eczema, unspecified cause (692.9), primary localized osteoarthrosis (715.18), osteoarthrosis, unspecified whether generalized or localized (715.90), unspecified arthralgia (719.40), lower leg arthralgia (719.46), multiple site arthralgia

on what constitutes a "Gulf War Illness," in order to evaluate the incidence of prewar conditions commonly diagnosed among veterans of the war we used the 25 most frequent ICD-9-CM diagnoses (other than "healthy") among Army veterans registered with the CCEP who received a clinical evaluation. These Gulf War-prevalent illnesses are referred to as Gulf War Illnesses (GWI) throughout this text. Hospitalization with a primary diagnosis including any of these conditions was used to indicate a GWI hospitalization independent of deployment status. Any hospitalization occurring prior to August 1, 1990 was included for analysis with the earliest hospitalization cases occurring in 1980. For purposes of these descriptive analyses, hospitalizations were counted once per individual in each of the three categories.

Stressors, distress, risk-taking propensity, and general mental well being were assessed through several HRA variables. Because there were multiple measures with the potential for collinearity we grouped some of the HRA variables into one single index measure. The process used for grouping any of the HRA variables began with *a priori* consideration of logical groupings and confirmation of groupings with factor analysis. Where proposed groupings could not be confirmed through factor analysis we left the items ungrouped.

Six variables assessing behavioral risk for alcohol dependence were grouped because intercorrelations were quite high. The resultant composite alcohol use measure comprised the 4 CAGE items (27) and two additional, similarly scaled items: "friends worry about your drinking," and "ever have a drinking problem." The CAGE is a clinical screening tool used to identify individuals at risk for alcohol dependency. Thus we refer to the composite variable (CAGE plus the two related items) as "dependent drinking." Survey-takers missing responses to three or more of the items were excluded. The remaining items were used to develop an average response. These responses were dichotomized, based upon the distribution of responses for the entire population, into two categories: those with no affirmative responses (84%) versus those with 1 or more affirmative responses.

Other variables used for analysis included feeling so overwhelmed the respondent had considered hurting him or herself, considering suicide or experiencing prolonged depression within the past year, experiencing worries that interfered with life, problems with spouse, children or peers, work stress, low satisfaction in current job assignment, low life satisfaction, frequent losses in past year, and little time for relaxation. We also included self-reported daily tobacco use, weekly drinking consumption, and risk-taking habits. The latter being comprised of drinking alcohol before driving or riding with someone who had been drinking, speeding, use of a motorcycle, and seatbelt usage.

Analytic Methods

Exploratory analysis was conducted using frequency distributions and Chi-square tests. Continuous variables were compared using t-tests. To compare prewar differences in health behaviors, and experiences of stressors and distress between deployed and non-deployed cohorts, Chi-square analysis was used. Multiple logistic regression analyses, with deployment as an outcome, were conducted in order to explore the relationships between the explanatory variables. Occupation, gender, and rank were highly correlated. Therefore we constructed different models, selecting the most commonly deployed occupational groups in each gender-rank group for comparison purposes.

To compare differences between deployed and non-deployed cohorts in their risk for hospitalization before the war, while controlling for differences in exposure potential (time in service), multivariate Cox proportional hazard models were used. Soldiers were followed from entry into the Army (or from January 1, 1980 for those who entered the Army before 1980) until their first hospitalization event occurred or until August 1, 1990 (censored date). In 1990, only hospitalizations occurring before August 1, 1990 were included for comparison, as this was one day before Iraq's invasion of Kuwait and one week before the

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(719.49), lumbago, not otherwise specified (724.2), myalgia and myositis, unspecified (729.1), other insomnia (not otherwise characterized), (780.52), other and unspecified sleep apnea (780.57), malaise and fatigue (780.7), other general symptoms which may include amnesia (retrograde), chills not otherwise specified, generalized pain, hypothermia not related to low environmental temperature, (780.9), rash and other non-specific skin eruptions (782.1), and headache, including facial pain and other pain in the head that is not otherwise specified (784.0) (TAIHOD Database, May 1999).

arrival of US planes in Saudi Arabia. Thus, we hope to reduce potential bias that might result if an individual sought hospitalization to avoid deployment.

To identify changes in risk for hospitalizations as a function of time and proximity to the deployment period, logistic regression models predicting hospitalization for any cause, for injuries, and for GWI were also constructed for each year in the prewar period. Beginning in 1980, models compared rates in each year for soldiers who ultimately deployed to those who did not deploy. The potentially confounding influences of gender, age, race/ethnicity, time in active military service, education, and rank were included in the models.

SAS was used to develop multivariate models and initial exploratory models (28). Bivariate associations between self-reports on the HRA and deployment status were evaluated using EpiInfo (29). Exact odds ratios, confidence intervals, and two-sided p-values were used, since many of the tables included sparse cells.

RESULTS

There were 675,626 Army soldiers on continuous active duty during ODS/DS. Thirty-eight percent (257,699) were deployed to the Persian Gulf between August 1, 1990, and June 1, 1991.

Deployers were more likely to be male, have fewer than five years of time in service, be under 25 years of age, black, single, high school graduates, have fewer dependents, and be junior enlisted and junior officer rank, than their non-deployed counterparts (Table 1). Thirty-nine percent of men on active duty during the war deployed compared to 29% of the women on active duty; 46% of those under age 21 deployed compared to 28% of those over age 35; and almost half of those enlisted with a grade of E1-E4 (45%) deployed compared to 10% of officers with a grade of O6-O11 (data not shown).

Deployers were also more likely to have received hazardous duty pay *prior to* July 1990 (See Table 1). Deployed enlisted soldiers were more likely to be in infantry/gun crews, mechanical equipment repair, or crafts worker (e.g., plumbers, metal workers) occupations. Deployed officers were significantly more likely to belong to the tactical operations or supply and procurement, engineering and maintenance or intelligence officer occupational group. Deployed warrant officers were significantly more likely to be in the tactical operations occupational groups.

-- Insert Table 1 here --

In Table 2 we investigate whether demographic characteristics described in Table 1 are independent predictors of deployment in multivariate logistic regression models. Because gender, rank, and occupation are highly correlated (with numerous potential occupational categories) we conducted separate sub-analyses based on occupations most commonly deployed to the Gulf within each gender-rank group. The results from these multivariate logistic regression models show factors explaining variation among those who deployed and those who did not deploy in occupations with the highest rates of deployment to the Gulf.

Factors consistently associated with deployment across all four occupations included younger age (mostly less than age 25), less time in service (particularly those in the service less than 5 years), having fewer than 2 dependents, and having a spouse on active duty who was also deployed to the Gulf. Also, those with less education were more likely than their more highly educated counterparts to deploy. Enlisted male and female soldiers of lower rank were significantly more likely to be deployed than their higher-ranking counterparts. This was also true of female officers but not male officers. Male enlisted and male officers with special pay for exposure to two or more occupational hazards were more likely to deploy than males in these same occupations who had received no hazardous duty pay.

-- Insert Table 2 here --

Three hundred and seventy-four of the 675,626 soldiers on active duty during ODS/DS had taken a HRA taken prior to August 1, 1990. Deployers were less likely to have seriously contemplated suicide or to have experienced prolonged or repeated periods of depression within the past year. They were *less* likely to say that life had been so overwhelming they had considered hurting themselves, worries had ever interfered with their daily lives, they were not satisfied with their life or jobs, they had experienced family problems or personal misfortunes, or that they never had time to relax. They were also *less* likely to answer affirmatively to the dependent drinking measure. Similarly, those who deployed were more likely to say they had experienced a *pleasant* life change in the past year. Though the direction of these associations is consistent, we are unable to rule out the role of chance in these associations due to small sample sizes and tight control of Type I and II errors.

A trend was observed suggesting that those who deployed are more likely to engage in risky behaviors such as drinking alcohol before driving, speeding, and are less likely to wear their seatbelts while driving.

-- Insert Table 3 here --

In multivariate Cox proportional hazards models (controlling for gender, age, race, education, marital status, time in service, rank, and prewar receipt of hazardous duty pay) deployed status remained significantly associated with *reduced* risk for a hospitalization for any cause or for one of the conditions commonly documented among Gulf War veterans, though the risk differences were quite small. There was no significant difference in risk of injury hospitalization between deployed and non-deployed Gulf War era veterans. Male gender, young age, less education, single marital status, less time in service, and receipt of two or more types of hazardous duty pay in a pay period were all significant predictors of prewar injury hospitalization (data not shown).

Figures 1-3 depict the association between deployment and adjusted odds of hospitalization during each year of the follow-up period. Figure 1 shows that deployers were at lower risk for hospitalizations due to any cause, particularly in the period immediately before ODS/DS, even after controlling for gender, age, race/ethnicity, time on active duty, education, and rank.

-- Insert Figure 1 Here --

Deployed soldiers were not at greater risk for a prewar GWI hospitalization than were non-deployed Gulf War era veterans. There was a largely consistent pattern of risk in the prewar period where those who ultimately deployed were actually at *lower* risk for a hospitalization related to any of the diagnoses most commonly seen among veterans seeking care for GWI after the war (Figure 2).

-- Insert Figure 2 Here --

In most years prior to ODS/DS deployers were at greater risk for an injury hospitalization than were their non-deployed counterparts. This was true even after accounting for the effects of gender, age, race, time in service, education, and rank (Figure 3). To refine this analysis we also constructed an age-specific model including just soldiers under age 26. Even among this very young cohort, injury risk in almost every year prior to ODS/DS was significantly higher among soldiers who ultimately deployed than among those who did not (data not shown).

-- Insert Figure 3 Here --

DISCUSSION

Without good, prewar baseline information it is difficult to make a cogent assessment about the postwar health consequences of service in the Persian Gulf. There have been relatively few studies documenting prewar health and mental status of soldiers deployed to the Persian Gulf. The few studies that have focused on or at least briefly described differences between those who deployed and those who did not deploy to the Gulf note that veterans deployed to the Gulf were disproportionately male and younger than veterans deployed elsewhere (1, 18, 23). They were also more likely to be married than their non-deployed counterparts, and differed significantly with respect to race or ethnicity, branch of service, activation status (e.g., reserve vs. active duty) and grade (1, 18, 23). Deployed veterans were more likely to be discharged or separated from the military soon after the war, although not because of death or medical disability (23). Gray et al. also note that military personnel who were sent to the Gulf had fewer prewar hospitalizations up to the point of deployment than their non-deployed counterparts, particularly in the years immediately preceding ODS/DS, similar to what we document among active duty Army (23). We expand upon these earlier observations by examining a longer time-period and by including an assessment of prewar risk-taking differences, self-appraised distress and well being, and by focusing on active duty Army. We also expand upon the strengths of earlier studies by using a comparison group that was more restrictive than that used by many other researchers. We reduce potential bias by only including non-deployed Gulf War era veterans who were on active duty throughout the entire ODS/DS period.

Our data suggest that before the war Army soldiers who ultimately deployed to the Persian Gulf were significantly healthier and happier than their non-deployed counterparts, as measured by their hospitalization histories and self-reports. They were significantly less likely to report prewar experiences of depression or suicidal ideation and they were significantly less likely to have experienced any prewar hospitalizations and, most noteworthy, hospitalizations for conditions most prevalent among postwar Army veterans seeking care. The data also suggest that deployed personnel were happier in their personal lives (families, life events) and jobs prior to the war than their non-deploying counterparts. Though small sample sizes limited our ability to detect statistically significant differences in many cases between the two cohorts, the consistency of the findings across measures of satisfaction and general well being is compelling.

There is some evidence indicating that soldiers who deployed to the Gulf may have been greater risk takers prior to deployment, and/or may have faced greater hazards than non-deployed Gulf War era veterans. They were more likely to have received hazardous duty pay for 2 or more different hazardous exposures *before* being deployed to the Gulf War theatre. These prewar differences are driven primarily by more frequent receipt of pay for parachuting or for potential exposure to hostile fire. Indeed, these attributes or experiences might make the candidates likely prospects for wartime deployment.

Other evidence for excess prewar risk taking or risk exposure among deployers can be found in the records of prewar hospitalizations and self-reported behaviors. For most years between 1980-1990 annualized odds for injury hospitalizations were higher than for those not deployed, even after adjusting for potential confounders. Similarly, nonsignificant trends were observed which suggested that soldiers deployed to the Gulf were more likely to speed, drive after having had too much alcohol, or ride with someone who had consumed too much alcohol, and were less likely to always wear their seatbelt.

Having a spouse who also deployed was a significant predictor of deployment to the Gulf. This may be an important modifying factor, and should be considered in future studies examining risk factors for Gulf War-related illnesses. This seems particularly important given the findings of Gray et al. who note that even after controlling for several confounders married personnel were at greater risk for postwar hospitalizations for all causes (23). Perhaps those who were married are at greater risk for postwar hospitalizations because they were likely to have a spouse also deployed to the Gulf. These veterans might be experiencing even greater distress due to concerns about the well being of their deployed spouses.

There are a few potential weaknesses of this study that deserve comment. First, because the HRA program was initiated in late 1987 there are relatively few HRAs in the prewar time period, with the bulk of those used in this study coming from the years 1989 and 1990. However, because we are interested in

prewar experiences of stressors or distress, and health habits as they relate to postwar health, the close proximity of HRA measures we do have to the start of the ODS/DS period may also be considered a strength of this study. In addition, in spite of small samples we are still able to demonstrate a significant difference in risk for depression and suicidal ideation in the prewar period. Second, the measures of health behaviors and life quality from the HRA are self-reported and cannot be directly validated by assessment of actual practices and life stressors. However, many studies have validated self-reported behaviors and found good correspondence between actual and reported behaviors (30-36). The use of hospitalization diagnoses common among Army CCEP registrants may reduce generalizability of our findings as not all veterans of the Persian Gulf chose to register or receive clinical evaluation under the CCEP program. Finally, the cohort defined here includes those who were on active duty for the entire ODS/DS period. Thus, individuals who enlisted during the war or who were discharged during the war are not included.

CONCLUSIONS

It seems unlikely, given these data, that any single prewar factor, such as excess stress, distress, difficulty coping, or poor health, will completely explain the health concerns and illnesses Gulf War veterans have experienced since the war. Recent research suggesting that post-war excess distress and depression is higher among those who deployed is likely to be a response to the war experience and not due to some prewar condition. However, the excess postwar injury mortality may be due to risk-taking habits or exposures that were present prior to deployment, and which persisted even after the war. Though there is some cohesive evidence for excess risk taking among deployers prior to the war, the strength of the evidence is weak. More information is needed documenting postwar risk-taking habits, particularly longitudinal data capable of documenting changes in habits that may have occurred after deployment.

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Table 1. Univariate analyses describing the demographic characteristics of 675,626 Army soldiers on active duty during the Gulf War by deployment status during the Persian Gulf War*

	Deployer (N=257,699) %	Non Deployer (N=417,927) %
Gender		
Male	91.64%	87.12%
Female	8.36%	12.88%
Age		
<21 years	15.04%	11.07%
21-25 years	37.15%	28.09%
26-30 years	22.58%	21.94%
31-35 years	13.56%	17.64%
36-40 years	7.92%	12.50%
>40 years	3.75%	8.73%
Race/Ethnicity		
White	60.85%	62.82%
Black	30.67%	28.63%
Hispanic	4.15%	3.96%
Asian/Pacific Island	1.43%	1.82%
Indian/Alaskan	0.56%	0.50%
Other	2.32%	2.24%
Educational Level		
Less than high school	1.21%	0.89%
High school graduate/GED	84.35%	75.29%
Alternate education	0.03%	0.03%
Some college	3.43%	4.94%
Bachelors degree	7.75%	10.98%
Graduate degree	2.10%	6.67%
Unknown	1.13%	1.22%
Marital Status		
Single	43.31%	34.00%
Married, spouse not on active duty	49.93%	56.98%
Married, spouse on active duty & deployed	1.95%	0.95%
Married, spouse on active duty & not deployed	1.57%	3.65%
No longer married	3.20%	4.27%
Unknown	0.03%	0.15%
Dependents		
Member only	44.93%	36.65%
Member +1 dependent	17.57%	17.50%
Member +2 or more dependents	37.32%	45.56%
Unknown	0.19%	0.29%
Rank		
E1-E4	54.39%	41.33%
E5-E9	34.92%	41.41%
Warrant Officer	2.20%	1.95%
O1-O3	6.53%	9.08%
O4-O5	1.77%	5.26%
O6-O11	0.18%	0.97%
Time in Service		
Less than 6 months	3.99%	4.50%

	Deployer (N=257,699) %	Non Deployer (N=417,927) %
6-12 months	10.94%	7.89%
13-24 months	16.31%	10.88%
2-5 years	31.71%	26.20%
6-10 years	18.34%	20.13%
11-15 years	11.10%	15.59%
16-20 years	6.31%	11.27%
>20 years	1.26%	3.49%
Unknown	0.03%	0.05%
Hazardous Duty Pay		
No hazardous duty pay	86.41%	87.08%
Hazardous duty pay 1 type	12.81%	12.37%
Hazardous duty pay 2 or more types in pay period	0.78%	0.55%
Enlisted (n=575,942)		
Infantry/Gun crews	27.58%	24.34%
Mechanical equipment repair	18.99%	13.38%
Communication/ Intelligence	14.01%	14.13%
Support/ Administration	12.17%	18.26%
Service/ Supply	11.76%	11.15%
Health Care	5.09%	8.24%
Electrical equipment repair	4.60%	5.29%
Technical/ Allied specialist	2.93%	2.96%
Craftsworkers	2.61%	1.77%
Non-occupational	0.25%	0.44%
Other	0.01%	0.03%
Officer (n=85,874)		
Tactical operations officer	40.86%	27.02%
Non-occupational	12.10%	19.06%
Health care officers	12.10%	18.91%
Supply, procurement & allied officers	10.37%	7.11%
Engineering & maintenance officer	10.35%	8.54%
Intelligence officer	5.24%	4.50%
Administrators	4.90%	7.40%
Scientists & professionals	3.78%	6.79%
General officer/Executive	0.26%	0.52%
Other	0.05%	0.15%
Warrant (n=13,810)		
Tactical operations officer	49.09%	37.77%
Engineering & maintenance officer	26.44%	25.37%
Supply, procurement & allied officers	7.76%	7.42%
Non-occupational	4.91%	6.31%
Intelligence officer	4.38%	7.34%
Health care officers	3.77%	3.75%
Administrators	3.49%	11.28%
Scientists & professionals	0.14%	0.64%
Other	0.02%	0.12%

* Values are those documented in June 1990 DMDC records. All univariate associations were statistically significant at p<.05

Table 2. Multivariate logistic regression analyses of individual characteristics related to deployment to the Persian Gulf. By occupation-rank-gender groups most often deployed to the Gulf (Odds ratios for deployment and 95% confidence intervals)

	Infantry & Gun Crews N=146,864 (Male Enlisted)	Support & Administration N=25,248 (Female Enlisted)	Tactical Operations N=31,427 (Male Officer)	Health Care N=4,566 (Female Officer)
Age				
17–20 years	2.5 (2.3–2.7)	2.8 (2.2–3.5)	3.0 (0.9–9.4)	N/A
21–25 years	2.4 (2.3–2.6)	2.3 (1.8–2.8)	4.3 (3.9–4.7)	2.1 (1.6–2.7)
26–30 years	1.8 (1.6–1.9)	1.9 (1.5–2.4)	3.3 (3.1–3.6)	1.4 (1.1–1.8)
31–35 years	1.4 (1.3–1.5)	1.5 (1.2–1.8)	2.0 (1.8–2.1)	1.3 (1.0–1.7)
36–40 years	1.2 (1.1–1.3)	1.1 (0.9–1.4)	1.9 (1.7–2.1)	1.0 (0.8–1.3)
>41 years	1.0	1.0	1.0	1.0
Race/Ethnicity				
White	1.0	1.0	1.0	1.0
Black	1.0 (1.0–1.0)	1.1 (1.1–1.2)	0.9 (0.8–1.0)	0.9 (0.7–1.2)
Hispanic	1.0 (0.9–1.0)	1.3 (1.1–1.5)	0.8 (0.7–1.0)	1.0 (0.5–1.9)
Indian/Alaskan	1.0 (0.9–1.2)	1.1 (0.8–1.6)	1.1 (0.8–1.6)	0.7 (0.2–3.2)
Asian/Pacific Islander	0.9 (0.8–1.0)	0.8 (0.7–1.0)	0.8 (0.6–1.0)	0.7 (0.4–1.3)
Other	1.0 (0.9–1.0)	1.1 (0.9–1.4)	0.9 (0.7–1.1)	0.8 (0.4–1.6)
Education				
Less than high school	2.9 (1.7–4.9)	4.7 (1.7–13.3)	2.3 (0.4–13.8)	N/A
High school graduate/GED	2.8 (1.7–4.7)	3.3 (1.4–7.6)	3.8 (3.3–4.3)	N/A
Alternate education	3.0 (1.4–6.2)	N/A	N/A	N/A
Some college	1.9 (1.1–3.2)	2.2 (1.0–5.3)	3.0 (2.7–3.4)	N/A
Bachelor's degree	2.0 (1.2–3.4)	2.1 (0.9–5.1)	2.1 (1.9–2.2)	2.1 (1.8–2.5)
Graduate degree	1.0	1.0	1.0	1.0
Marital Status				
Single	1.5 (1.5–1.5)	1.3 (1.2–1.4)	1.5 (1.4–1.6)	1.4 (1.1–1.7)
Married, spouse not on AD	1.0	1.0	1.0	1.0
Married, spouse on AD, not deployed	0.7 (0.7–0.8)	0.5 (0.4–0.5)	0.9 (0.7–1.1)	0.7 (0.5–1.0)
Married, spouse on AD, deployed	2.4 (2.0–2.9)	2.7 (2.5–3.0)	3.9 (2.8–5.3)	1.9 (1.3–2.6)
No longer married	1.0 (0.9–1.1)	0.8 (0.7–0.9)	1.0 (0.9–1.2)	1.3 (1.0–1.7)
Dependents				
Member only	1.6 (1.6–1.6)	1.3 (1.3–1.4)	1.7 (1.6–1.8)	1.7 (1.4–2.1)
Member + 1	1.3 (1.3–1.3)	1.1 (1.0–1.2)	1.6 (1.5–1.7)	1.1 (0.9–1.5)
Member + 2 or more	1.0	1.0	1.0	1.0
Rank				
E1–E4	1.6 (1.6–1.6)	1.6 (1.5–1.7)	N/A	N/A
E5–E9	1.0	1.0	N/A	N/A
O1–O3	N/A	N/A	0.8 (0.8–0.9)	10.4 (2.5–42.2)
O4–O5	N/A	N/A	0.4 (0.4–0.4)	6.3 (1.5–25.7)
O6–O11	N/A	N/A	1.0	1.0
Time in Service				
<6 months	2.2 (1.9–2.4)	4.6 (1.8–11.7)	1.9 (1.3–2.8)	1.0 (0.4–2.3)
6–12 months	3.2 (2.9–3.6)	5.4 (2.1–13.5)	5.5 (4.6–6.6)	3.2 (1.6–6.2)
13–24 months	2.9 (2.6–3.2)	7.0 (2.8–17.6)	5.7 (5.0–6.5)	3.2 (1.7–6.2)
2–5 years	2.8 (2.5–3.1)	4.1 (1.6–10.3)	4.5 (4.0–5.1)	2.6 (1.4–5.0)
6–10 years	1.8 (1.7–2.1)	3.6 (1.5–9.1)	2.9 (2.6–3.3)	2.5 (1.3–4.7)
11–15 years	1.6 (1.4–1.7)	2.6 (1.0–6.4)	2.6 (2.3–2.9)	1.8 (0.9–3.5)
16–20 years	1.3 (1.1–1.4)	1.8 (0.7–4.7)	1.9 (1.6–2.1)	1.6 (0.8–3.2)
>20 years	1.0	1.0	1.0	1.0

	Infantry & Gun Crews N=146,864 (Male Enlisted)	Support & Administration N=25,248 (Female Enlisted)	Tactical Operations N=31,427 (Male Officer)	Health Care N=4,566 (Female Officer)
Hazardous Duty Pay				
No hazardous duty pay	1.0	1.0	1.0	1.0
Hazardous duty pay 1 type	0.8 (0.8–0.9)	0.8 (0.7–0.9)	2.0 (1.8–2.2)	0.3 (0.0–2.2)
Hazardous duty pay 2 or more types in pay period	1.4 (1.3–1.5)	0.2 (0.0–1.7)	5.1 (2.9–8.8)	N/A

Table 3. Prewar self-reported depression, distress, stress, and risk-taking behaviors and univariate associations with deployment to the Persian Gulf among 374 Army soldiers completing an HRA prior to August 1, 1990. Percent of deployed and non-deployed Gulf War era veterans reporting risk factors and odds ratios for the risk factor (deployed versus non-deployed).

Risk Factor	Deployed (n=106) %	Non-Deployed (n=268) %	OR**	95% C.I.	2-tailed p-value
Reports considering suicide or reports experiencing prolonged/repeated periods of depression in past year (vs. never)	20%	31%	0.56	0.31-0.99	0.04
Reports feeling so overwhelmed with life he/s considered hurting self in past year (vs. never)	2%	4%	0.45	0.05-2.13	0.37
Reports worries have interfered with daily life over past year (vs. never)	44%	49%	0.83	0.51-1.34	0.42
Reports having had serious problems dealing with spouse, parents, children, or friends (vs. never)	62%	70%	0.70	0.43-1.16	0.14
Reports feeling only somewhat or not satisfied at all with life in general (vs. mostly or totally satisfied)	14%	20%	0.66	0.33-1.26	0.19
Reports having experienced personal misfortune in past year (vs. none)	53%	61%	0.73	0.45-1.18	0.17
Reports feeling they are not satisfied with their current job (vs. somewhat, mostly, or totally satisfied)	67%	72%	0.77	0.44-1.37	0.34
Reports feeling there is sometimes too much work stress (vs. never)	73%	68%	1.23	0.72-2.12	0.43
Reports he/s seldom or never has time to relax (vs. sometimes or often)	14%	17%	0.87	0.42-1.65	0.62
Responds yes to 1 or more dependent drinking measures (vs. "no" to all)	11%	18%	0.55	0.25-1.21	0.11
Reports current smoking habits as					
Current-Smoker	21%	22%	0.93	0.50-1.71	0.82
Ex-smoker	21%	22%	0.90	0.48-1.65	0.90
(vs. never smoked)					
Reports he/s has often or sometimes experienced pleasant life change in past year (vs. seldom or never)	62%	39%	1.45	0.89-2.37	0.11
Reports engaging in at least 1 high risk driving practice in past month or typically (vs. none)*	53%	46%	1.34	0.83-2.16	0.20

* Reports drinking and driving 1 or more times in past month, or speeding more than 5 miles over the limit, or not wearing seat belt 100% of the time.

** Exact methods used to calculate odds ratios, 95% confidence intervals and p-values [Prevention, 1997 #44]

Figure 1. OR and 95% CI for deployment status (outcome= any prewar hospitalizations 1980-1990) controlling for gender, age, ethnicity, total time in service, education, and rank

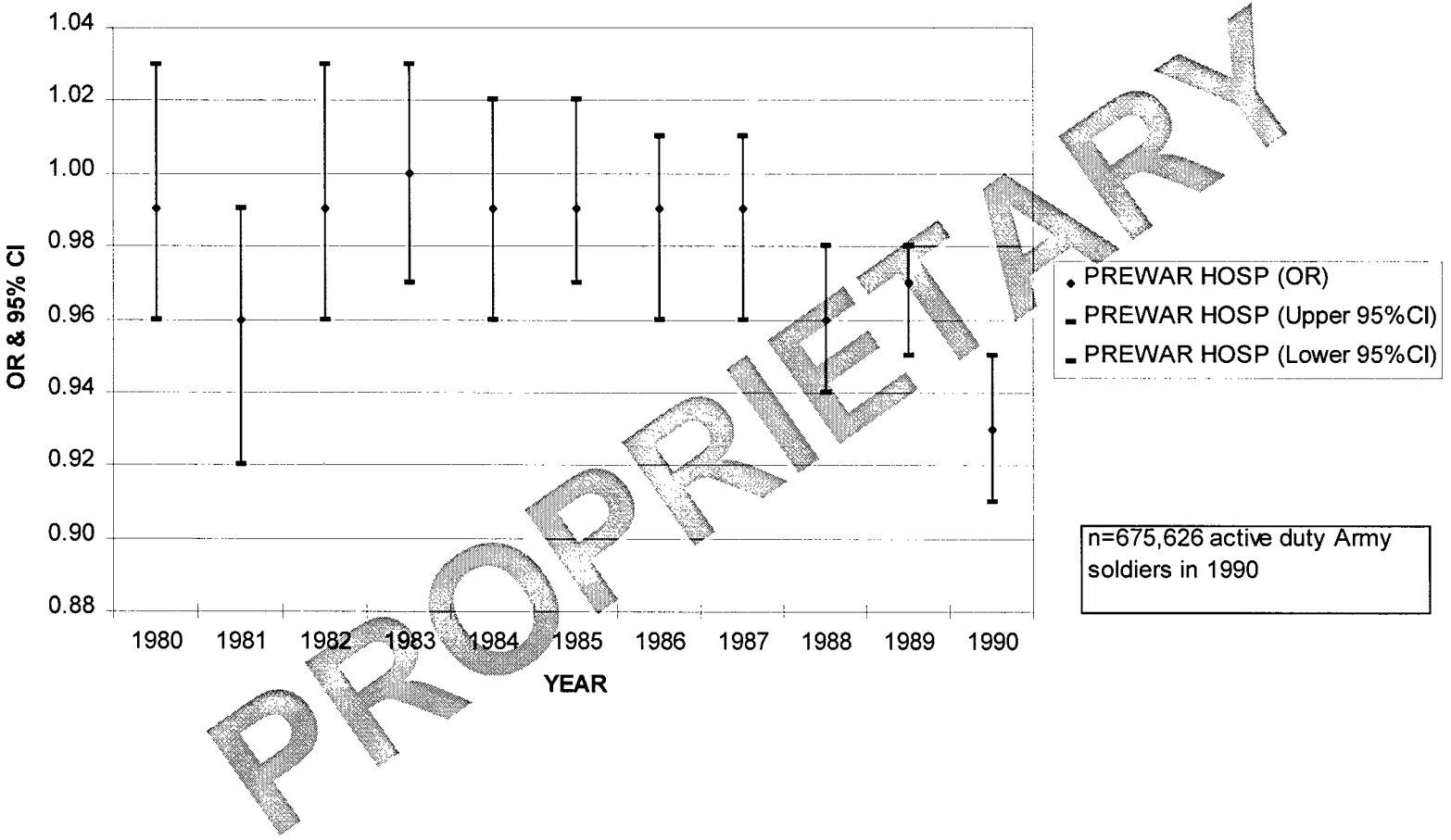


Figure 2. OR and 95% CI for deployment status (outcome = prewar GWI hospitalizations 1980-1990) controlling for gender, age, ethnicity, total time in service, education, and rank

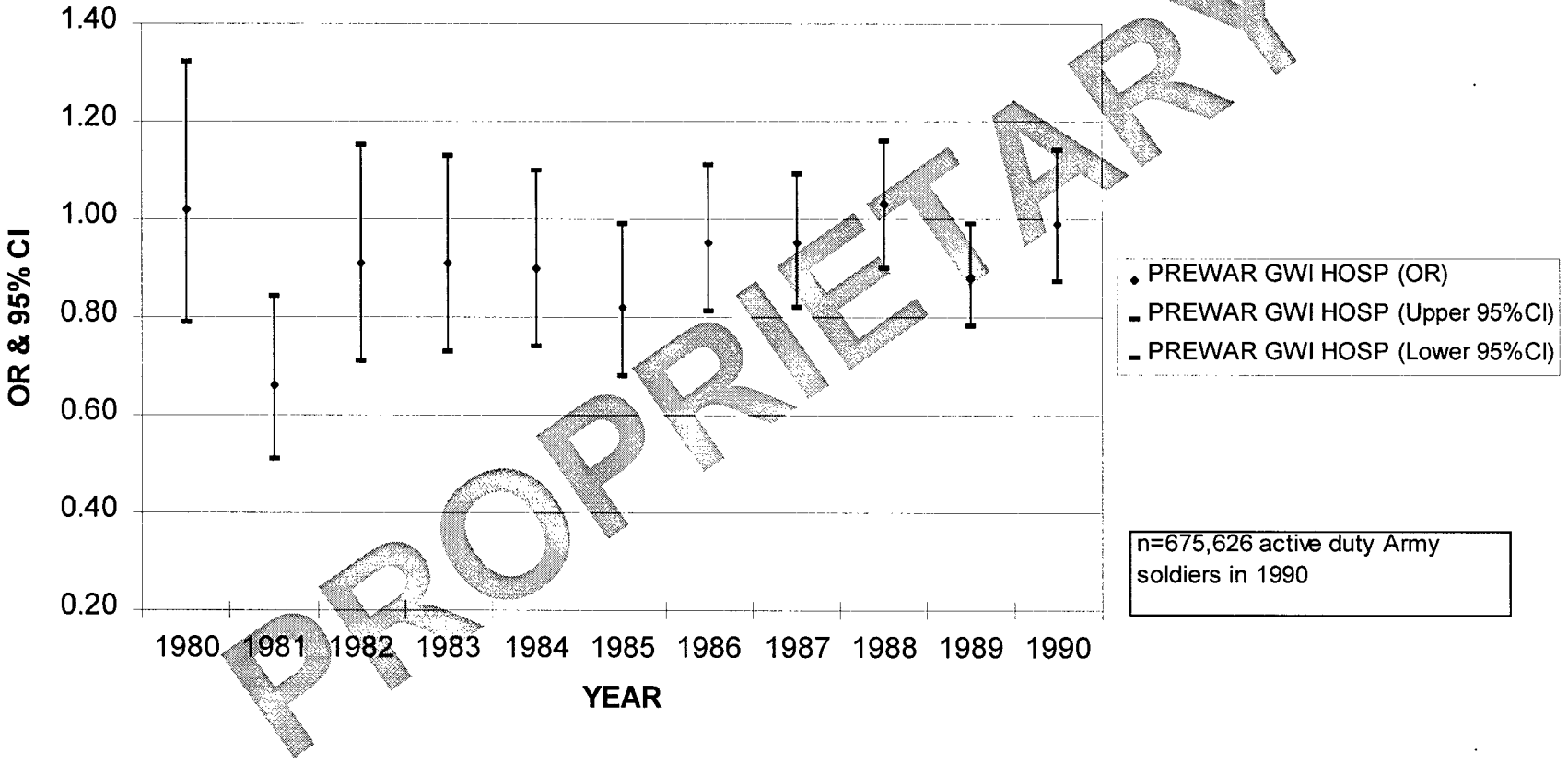
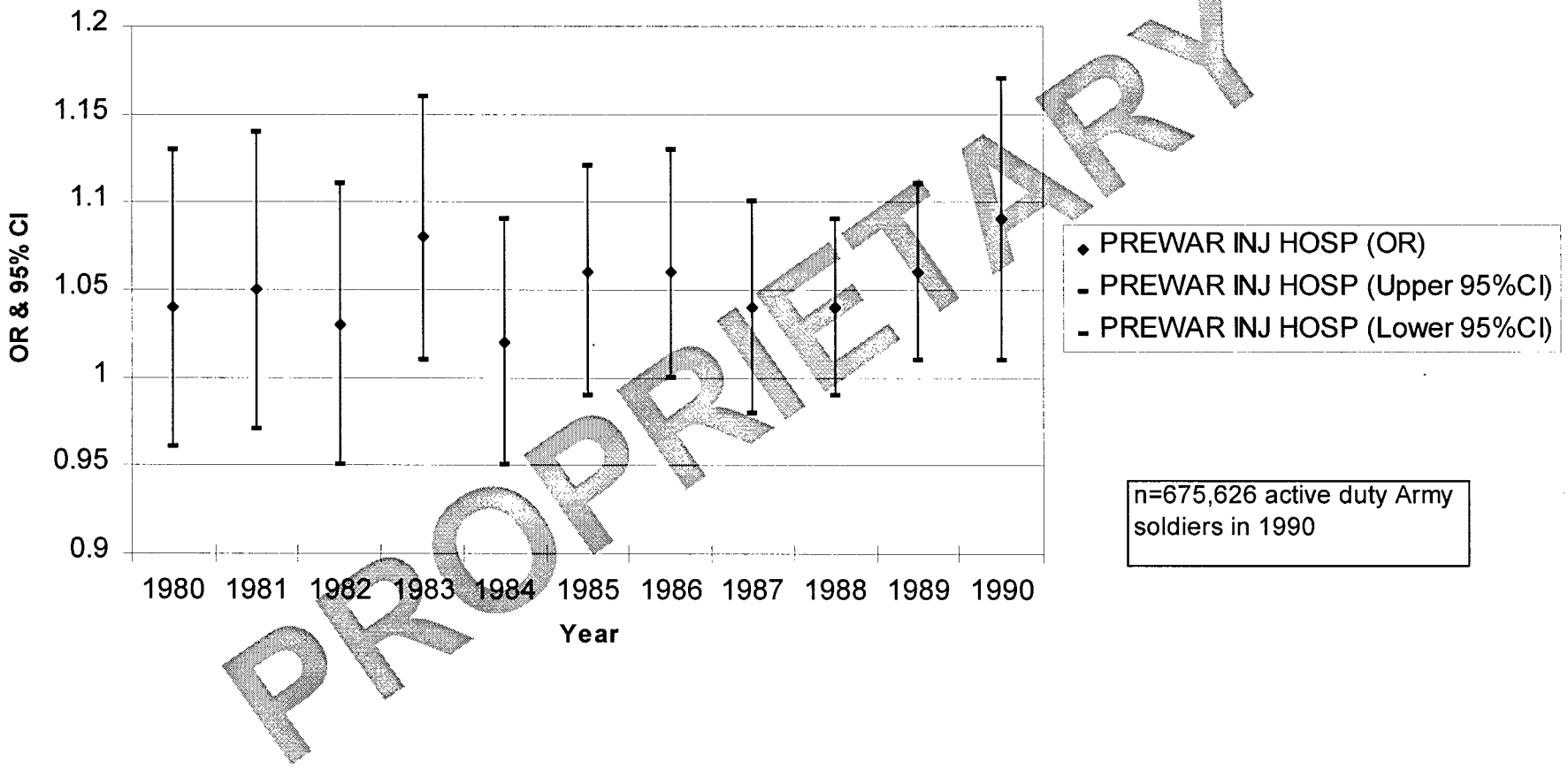


Figure 3. OR and 95% CI for deployment status (outcome = prewar injury hospitalizations 1980-1990) controlling for gender, age, ethnicity, total time in service, education, and rank



Appendix E. Injuries among Gulf War Veterans: Is it time to reconsider the research agenda?

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Injury is the only known cause of increased mortality among Gulf War veterans. Overall death rates have actually been lower among Gulf War veterans than among the US population at large. Gulf War veterans are at lower risk than their non-deployed counterparts for deaths due to infectious and parasitic diseases and, thus far, there have been no documented increase in risk for birth defects among children of deployed veterans[1-3]. The only significant difference documented to date in postwar mortality between soldiers deployed to the Gulf and Gulf-War Era veterans who were not deployed to the Gulf is that due to injuries [2, 3]. Even *during* Operation Desert Shield/Desert Storm (ODS/DS) unintentional injuries were a more common cause of fatality than battle-related injuries [4]. Non-fatal unintentional injuries and musculoskeletal conditions (which are often related to "old" injuries) also comprised the single greatest category of outpatient visits during the war, caused the largest number of days lost from duty, and was the most common reason for evacuation from the Gulf War theatre[5]. The differences in injury fatality risks have not, to our knowledge, been evaluated for etiological or preventive factors.

Very little information has been published regarding non-fatal postwar injury. Given the excess fatalities among veterans, it seems likely that injury morbidity may also be greater. However, it is also possible that the number of injury events experienced by deployed and non-deployed Gulf War Era veterans do not differ, but rather, only the outcomes differ (i.e., fatal vs. non-fatal). Because there have not been any studies that looked specifically at injury morbidity among ODS/DS veterans, we simply do not know how the frequency or severity of injuries differ for veterans deployed to the Gulf.

Despite the association between service in the Gulf and excess injury fatality, most research to date has focused on the search for a unifying case definition of "Gulf War Illnesses," and a search for an etiological pathway, or several pathways, to explain the myriad of symptoms and conditions reported by veterans of the Persian Gulf war. While the importance of these chronic multisymptom illnesses and the disability and suffering experienced by veterans should not be minimized, the lack of attention paid to the risk factors that contribute to elevated injury mortality, and to designing and implementing interventions to reduce injury mortality in this group of veterans is puzzling.

To date, with the exception of the four studies that merely describe the excess risk for non-battle injury mortality[2-5], discussion and review of injury among Gulf War veterans has been limited to studies describing battle-related injuries and/or their psychological sequelae[6-18]. We believe that injuries, as the only documented cause of excess mortality, should be given greater prominence on the research agenda. One of our top research priorities should be the examination of the plausible hypothesis that excess rates of postwar injuries are the direct result of experiences, or the indirect result of exposures, that occurred during service in the Gulf.

Recently a conference was convened that brought together Gulf War researchers, veterans, and policy makers[19]. In several presentations it was noted that injuries were the only documented cause of increased mortality among Gulf War veterans. Yet the research priorities identified for the near term included only those related to the treatment of symptom-based conditions, longitudinal follow up to understand the natural course of these conditions, identification of ways to improve detection of environmental hazards, and models for preventing deployment related illness conditions. Injury prevention and etiologic studies were conspicuously absent from the discussion. Similarly, several recent articles describe efforts currently underway and/or proposed for the near future to understand the chronic multisymptom illnesses and conditions experienced by ODS/DS veterans. Consistently, however, only passing mention is made of the documented excess injury mortality rate among Gulf War veterans[20, 21].

Since injuries are a more easily identified and measured outcome than, perhaps, multi-symptom illnesses, research into risk factors and effect modifiers may be quite cost-effective and result in more immediate health improvements for veterans of the Gulf War as well as those deployed in future conflicts and peacekeeping missions. These efforts are also likely to result in significant cost-savings to the federal government. Individuals currently receiving disability compensation from the Veteran's Administration total more than 2.2 million people. About a third of these individuals have conditions of the musculoskeletal system and receive direct payments of well over four billion dollars per year[22]. The vast majority of disability discharges due to musculoskeletal conditions are the end result of injuries that occurred while in the military[23].

The link between deployment to war zones and subsequent increases in non-battle injuries is not unique to the Gulf War. We agree with Hyams et al. that, in fact, these "Gulf War Illnesses and Conditions" may not be unique to the Gulf War *per se* but rather may be a result of war in general[24]. Symptoms and experiences commonly reported by veterans of ODS/DS are similar to those reported by veterans of other wars and conflicts[24]. For example, veterans of the Vietnam conflict also experienced greater risk for unintentional and intentional injuries resulting from motor-vehicle crashes, accidental poisonings, fires and burns, homicide, and suicide after returning home[25-30]. A CDC follow-up study found, however, that the elevated mortality for injury dissipated after five years, perhaps because those at greatest risk had died and/or the war-related exposures were no longer as potent a risk factor five years after the conflict[25]. In a recent presentation Kang reported evidence of a similar decline (i.e., return to baseline levels of injury mortality among veterans) subsequent to the Gulf War[31]. Suicide risk and PTSD were greatest among Vietnam veterans who had been wounded during battle and/or had experienced psychological trauma while in Vietnam[32-34]. Moreover, it is likely that the true suicide incidence is underreported. Some researchers have speculated that suicides due to somewhat ambiguous causes, such as poisonings, may be coded as "accidental" when they are in fact intentional self-inflicted injuries[35-37]. Three studies of postwar mortality among Vietnam veterans also demonstrated that they were at increased risk of death due to "accidental" poisonings[25-27].

As with the Gulf War, attention from the media, policymakers, and researchers on the problems of Vietnam veterans focused almost exclusively on health outcomes other than the observed increased risk for injuries. Indeed, many of the mortality studies among Vietnam veterans were initiated in response to concerns from veterans about a possible relationship between exposure to herbicides and elevations in cancer risk, and only found this excess of deaths due to traumatic causes serendipitously[25-28, 30]. Again, with respect to the Gulf War, there is a great deal of attention being paid to symptom-based illnesses, and relatively little to understanding the elevation in deaths due to external causes. Regardless of whether injuries are studied as a unique outcome of service in the Persian Gulf, or an outcome related to deployment in general, the association between elevated injury risk and war experience needs clarification.

A thorough examination of the relationship between deployment and injuries is undoubtedly hampered by the perception that unintentional injuries are the result of "accidents." Many people view

injuries as the end result of random, uncontrollable events. This fatalistic view is archaic and needs to be overcome. Injuries, like diseases, follow describable and predictable patterns. There are known, identifiable, and measurable risk factors. In addition, interventions can be designed and implemented to modify individual and environmental factors in such a way as to reduce the incidence of injuries. The Navy, for example, succeeded in reducing Class A aviation crashes from 100 per 100,000 flying hours to only 1.5 per 100,000 flying hours over the past fifty years. This impressive decline in loss of life and property has been accomplished through engineering changes (e.g., the angling of aircraft carrier decks) and persistent systematic application of training and safety initiatives[38]. Another example can be found by examining unintentional poisonings among children in the United States. Poisonings from drugs and medications declined by 50 percent in the first three years after childproof caps were required in 1973[37]. Similarly, studies have shown remarkable declines in fire- and burn-related injuries in communities that have instituted programs to distribute smoke detectors to residences[39, 40]. Counseling by a primary care physician has also been shown to reduce injuries[41-44]. Simple measures such as these, conscientiously applied and appropriately monitored, have been repeatedly shown to reduce morbidity and mortality from injuries.

A related explanation for the relative lack of attention being paid to injury mortality among veterans is that veterans who suffer from ill-defined conditions and symptoms have lobbied for research devoted to finding a cure or improved treatment for ailing veterans. By contrast, families of those killed in motor vehicle crashes or other injury events, or even veterans who are not fatally injured may not lobby for increased research into injury prevention if they too subscribe to the misconception that injuries are the end result of random events. Likewise, self-inflicted injuries may appear to have no external cause at all, mistakenly placing the blame on the individual. Veterans' advocacy groups may not lobby for increased review of self-inflicted injuries if they believe they are unavoidable tragedies.

Also, the determination about how Gulf War–related conditions are diagnosed, labeled, and categorized is greatly influenced by the clinical perspective and training of the physicians and researchers involved in the Gulf War research effort. Hence, rheumatologists might be more likely to diagnose fibromyalgia, internists chronic fatigue syndrome, psychiatrists PTSD, and specialists in occupational medicine multiple chemical sensitivities, even among patients who present with a very similar constellation of symptoms[45]. In a clinical setting, acute trauma is managed almost entirely in emergency departments and acute care clinics where there is often little continuity of care or long term follow-up and therefore no discovery or impetus for investigation of a potential common pathway. Unless and until the physicians treating victims of acute trauma broaden their understanding of the risk factors that might predispose a patient to injury to include deployment-related conditions, there will be little impetus to study injury etiology among veterans in greater depth. There are also few injury epidemiologists involved in the current Gulf War research effort, thus further reducing the likelihood that injuries will be included in clinical or research endeavors related to Gulf War Illnesses.

There are several ways in which service in the Gulf (or in war environments in general) may, in fact, be directly or indirectly related to injuries. In Figure 1 we describe several possible etiologic pathways for the documented increased injury risk observed among veterans of ODS/DS. First, the process that selects certain individuals for deployment may lead to a spurious association between deployment status and injury mortality during and after deployment by preferentially selecting individuals who are risk-takers. This might be viewed as a source of bias rather than a true etiological pathway. More directly, war-related depression might contribute to increases in self-inflicted injury; behavioral changes related to coping strategies (such as increased alcohol use) may increase risk of injury based upon the well-documented link between alcohol and injuries; and symptoms associated with certain chronic multisymptom conditions might affect cognitive or physical performance in such a way as to increase risk of injury (e.g., by affecting response time or hazard perception). These factors might have been present before the war (e.g., a predisposition to risk taking), or be triggered by the soldier's combat experience, elevating the soldier's risk of injury during the war. They may also persist beyond the end of the conflict and thus contribute to the observed excess postwar injury mortality among veterans. Any of these conditions or baseline characteristics might independently elevate risk of injury, or exacerbate an injury event once it has occurred, resulting in poorer outcomes of injuries among veterans deployed to

ODS/DS. A more detailed discussion of each of these possible pathways follows with appropriate references to known factors that support their theoretical basis.

-- INSERT FIGURE 1 ABOUT HERE --

1. An important explanation for excess injury morbidity that should be explored is the possibility of bias related to selecting individuals for deployment who are inherently at greater risk for injury. This increased injury risk may stem from a number of baseline personality or occupational characteristics such as: increased risk taking; belonging to an occupational group with documented hazards (e.g., vehicle drivers); recreational preferences (e.g., parachuting, bungee jumping or other sensation-seeking types of activities); or other baseline characteristics (e.g., smoking, alcohol consumption). These factors could elevate risk of experiencing an injury event and/or result in a poorer outcome after the event (e.g., it has been demonstrated that smokers are more likely to experience stress fractures, and that they take longer to heal than nonsmokers)[46, 47].

There is, to our knowledge, not yet any adequate baseline information in the literature that would allow risk-taking habits and injury predisposition among Gulf-War Era veterans prior to ODS/DS to be explored. It is plausible, however, that the same factors that might make a soldier a likely candidate for deployment to the Gulf may also be associated with greater risk of injuries independent of the war. Soldiers who are sensation-seekers or risk takers may be more inclined to self-select to serve in the Gulf or to be employed in occupational specialties with a higher likelihood of deployment (e.g., Infantry, Airborne, Rangers, and Special Forces). Our preliminary investigation demonstrates that soldiers who received hazardous-duty pay for activities such as parachuting or exposure to enemy fire in the period well before the start of ODS/DS were the same ones most likely to be deployed to the Persian Gulf, even after controlling for occupation. Bricknell et al. have also documented an increased risk for injuries among Army infantry who collect hazardous duty pay as compared to infantry who do not collect hazardous duty pay[48].

2. Equally important is the need to determine whether the increase in injury mortality (intentional and unintentional) is a consequence of increases in depression, PTSD, and symptoms of other psychiatric conditions subsequent to service in the Gulf. Such conditions have been documented among ODS/DS veterans[49-57]. Studies of other populations in non-military contexts have documented a link between psychologically distressed states, such as depression, and subsequent risk of self-inflicted injury[58-67]. It is also possible that these states may lead to an increased risk of unintentional injuries. Depression, for example, may slow response time, and is associated with the use of alcohol (a well-documented risk factor for almost every type of injury). Comorbidities of depression and alcoholism are known to increase risk for suicide[68, 69].

3. The physical and psychological traumas experienced during war may result in the postwar adoption of potentially unhealthy "coping behaviors." For example, several studies have documented an association between exposures to emotional or physical trauma and increased use of alcohol or other substances[70-74]. The association between alcohol use and increased risk for unintentional and intentional injury has been well documented in the literature. Changes in behavior may result from postwar depression or related mental conditions, or from attempts to self-medicate in order to alleviate symptoms. They may also occur independent of any diagnosed illness or condition yet still be an indirect consequence of an experience occurring in the Persian Gulf. For example, perceived near-death experiences have been shown to result in profound changes in values, beliefs, and behaviors as they relate to living and dying[75-77]. Such changes in beliefs and attitudes might result in more reckless behavior and less regard for personal safety.

4. The increased risk of injury could also be the indirect consequence of the ill-defined diseases and symptoms reported by many veterans, including fibromyalgia, chronic fatigue syndrome, and symptoms such as dizziness, shakes or tremors, unrefreshing sleep, fatigue, muscle and joint pain,

confusion and depression[78-86]. Whether or not these conditions are a direct consequence of service in the Gulf they are frequently reported by veterans of ODS/DS. These conditions may result in reduced response time or in an inability to safely negotiate his or her way out of a hazardous situation (e.g., collision avoidance in a motor vehicle). Alternatively or concurrently, a veteran suffering from these conditions might be more likely to make decisions that may increase exposures to hazardous circumstances. For example, they may be more inclined to enter a quarrel, which could escalate to interpersonal violence. Thus far, the documented association between service in the Gulf and increased injury mortality has not been evaluated to determine if certain sub-groups (e.g., those who are also suffering from multisymptom illnesses) are responsible for the observed differences in risk.

5. Finally, Kang and Bullman report only an excess of injury *mortality*[2]. Without an understanding of the prevalence of *non-fatal* injury among deployed and non-deployed Gulf War era veterans it is impossible to ascertain whether or not veterans are at increased risk for injury events or whether they are at increased risk for death (or poorer outcomes in general) once they are injured.

Psychological distress, coping behavioral responses, and illness-symptoms following service in the Gulf may all act as modifiers of an injury event. These illnesses and conditions may weaken a soldier so that he or she is less able to recover quickly from an injury. A veteran of ODS/DS who incurs a postwar injury may be more likely to experience adverse sequelae than an injured veteran who was not deployed to the Gulf, due to the presence of war-related co-morbidities.

Increased injury frequency or severity may stem from any of these proposed etiologic pathways, some combination of these pathways, or perhaps some other yet undiscovered pathway. In any case, injuries need to be further studied and should be added to the list of "Gulf War Illnesses and Conditions" so that the research effort is inclusive of all adverse health outcomes documented among Gulf War veterans.

Those interested in exploring the link between war exposure and non-battle injuries, and in designing prevention programs, need better information about the etiology of the increased injury risk among veterans. The following appear to be important steps in this effort: explore the role of risk taking behaviors prior to and subsequent to deployment; document the incidence of non-fatal injury among deployed and non-deployed veterans; determine whether there are sub-populations at unique or particular risk for these behavior changes; identify the potential modifying factors that protect individuals from experiencing injuries or suffering poor outcomes after a traumatic event; and evaluate the potential association between injuries and the symptom-based conditions commonly described by Gulf-War Era veterans. Longitudinal data sources that include measures of behavior both before and after ODS/DS, though hard to come by, would be particularly useful for providing these data. Focus groups or similar qualitative assessment tools may also provide important insights into risk-taking habits and changes in safety-related behaviors among Gulf War veterans.

We propose that the following specific research questions regarding injury risk among Gulf War veterans be added to the research agenda:

- What are the baseline exposures and behavioral characteristics of Gulf War era veterans during the period prior to deployment (e.g., risk taking habits, occupations, and recreational activities)?
- How do these change (if at all) postwar?
- Do deployed veterans have greater postwar injury *morbidity* than Gulf War era veterans not deployed to the Gulf?
- What is the relationship between postwar psychological health (e.g., PTSD, and depression) and subsequent risk of injury? Furthermore, how do specific war experiences, such as experiencing a battle-related injury, witnessing the death of another person, etc., affect these associations?

- Are there increases in postwar risky behaviors that might be "coping" responses? If so, how do these changes relate to injury risk?
- Are symptoms associated with the chronic multisymptom illnesses experienced by some Gulf War veterans associated with injury risk? If so, which symptoms or conditions have the strongest associations?
- Do any of these conditions or characteristics (e.g., illnesses, risk taking) modify injury sequelae?
- Are there important effect modifiers that mitigate these associations and thus reduce injury risk or adverse outcomes subsequent to an injury?

Once these questions have been answered, there are numerous intervention approaches that can then be employed to reduce the burden of intentional and unintentional injury among veterans and the resulting psychological and economic suffering experienced by their families. In order to begin thinking about interventions we first need to conduct well-designed studies to identify risk factors for injuries among veterans. This will not happen with a restrictive focus on chronic multisymptom illnesses to the exclusion of injuries. If these excess injury deaths among Gulf War veterans were instead attributable to cancer or heart disease, it would receive more than passing comment as an interesting phenomenon; researchers, clinicians, and veterans' advocates would be focusing efforts on a greater understanding of the etiology of these dreaded diseases, and searching for ways to reduce morbidity and mortality. Injuries must be seen as a condition potentially related to service in the Gulf. There must be high-level support for injury research in this population. Finally, there must be a reevaluation of the current research agenda and a re-prioritization of related activities.

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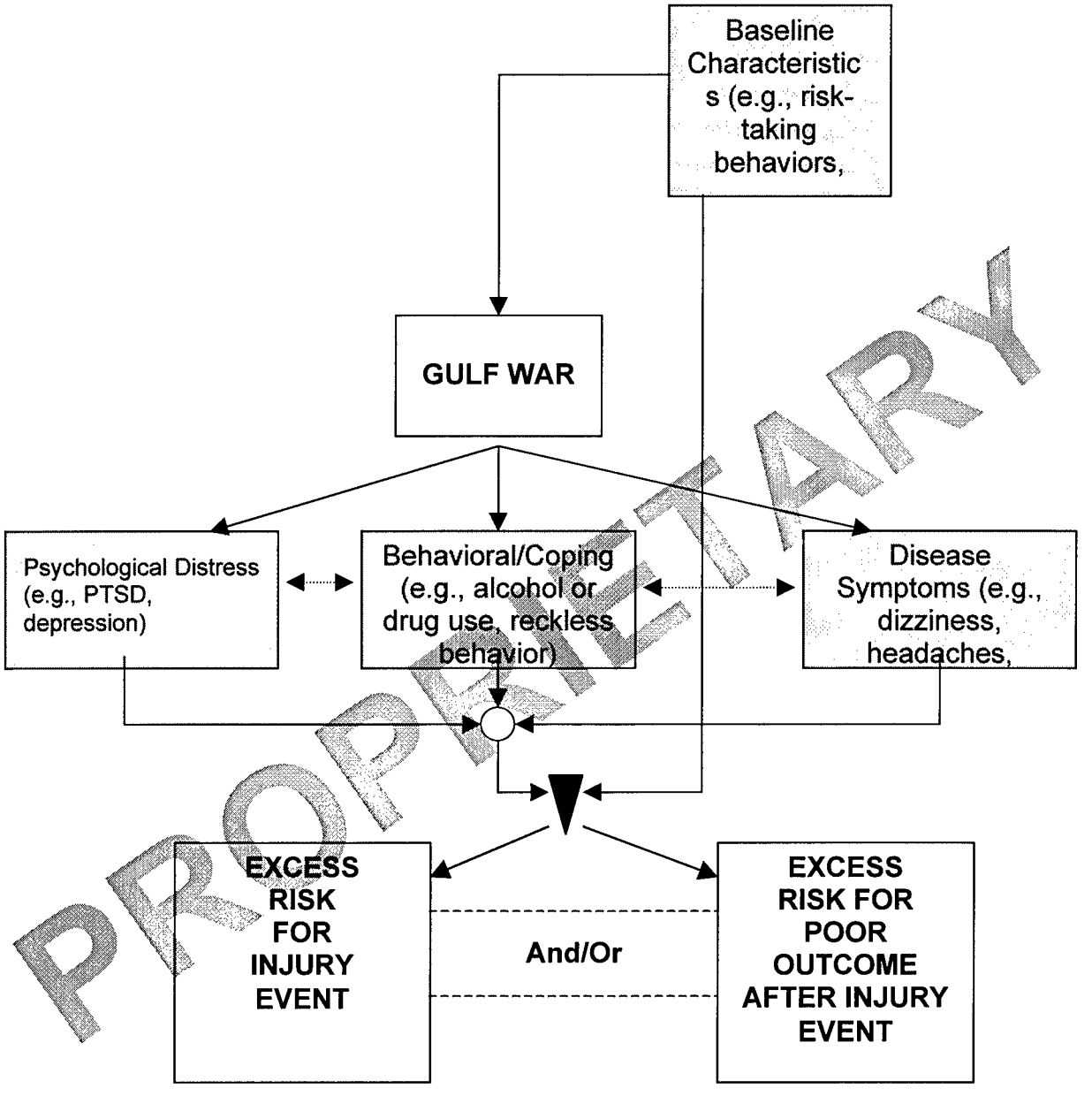
Figure 1. Potential etiologic pathways for the association between service in the Persian Gulf and injuries



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Appendix F. Preliminary Findings from Time-Series Analysis

Manuscript Working Title: "Incidence of Gulf War Illnesses over time and potential influence of external stressful events not related to deployment to the Persian Gulf."

NOTE: These results are preliminary and proprietary. They should not be cited or referenced without obtaining the express permission of Drs. Bell and Amoroso.

Many of the conditions commonly described by Gulf War veterans are likely to be treated on an outpatient basis. Unfortunately, outpatient data did not become available electronically until 1998. Hospitalization data going back to the early 1980s is available, but the utility of these data in assessing Gulf War Illnesses is not clear. To assess this we began with a comparison between 1998 outpatient data (latest year for which reliable data were available) and inpatient cases for diagnoses most common among Gulf War veterans[4] using rates per population of soldiers on active duty. Overall, the ratio of outpatient visits to hospitalizations for these conditions was 1 inpatient visit:426 outpatient visits. However, the ratio did vary some across type of diagnoses, probably reflecting relative morbidity/severity and/or the types of diagnostic tests indicated by the condition. Generally speaking, conditions that fell more in the psychiatric range appeared to be slightly more likely to result in a hospitalization (e.g., depression). Musculoskeletal conditions (e.g., pain in joint) and skin conditions (e.g., rash) appear less likely to result in hospitalization). This is an important finding as it has implications for the interpretation of other Gulf War studies that rely on hospitalizations as an indicator of morbidity and mortality among veterans of ODS/DS.

Evaluation of temporal trends in hospitalization for these conditions indicates that, as expected, there was an increase in rates in the year following ODS/DS. Though greatest for the soldiers who deployed to the Gulf, we also noted a significant increase in hospitalization rates among veterans who were not deployed. After this peak, admission rates trend down until 1994 when they again increase up through 1996 before declining. There are other less dramatic peaks in rates over the time period investigated (1981-1997). The peaks coincide with a number of events that might increase feelings of distress and thus result in an increased rate of stress-associated conditions. For example, a huge increase in media coverage of a possible Gulf War Illnesses peaked with the greatest number of articles occurring on or around January 1992 and immediately preceding an increased rate in hospitalizations for "GWI" conditions. The second peak following the Gulf conflict that occurred in June 1994 coincides with the introduction of the CCEP registration program (not a source of stress, but a possible cause for increased admissions as part of an evaluation process). Finally, the third peak observed in June 1996 coincides with the first DoD report of destruction of chemical weapons at the Kamisiyah dump (June 1996) and the September 1, 1996, letter sent to veterans notifying a large group of them of their possible exposure to sarin during the conflict. Also, most of these peaks also coincide with increased media coverage of external events such as proposed military downsizing. Multivariate models and refinement of our indicator and outcome measures are still required before these analyses will be completed. We expect to complete them by August 15, 1999.

[4] E.g., major depressive disorder, unspecified; neurotic depression; tension headache; prolonged posttraumatic stress disorder; depressive disorder, not elsewhere classified; migraine, unspecified; essential hypertension, unspecified; allergic rhinitis, cause unspecified; asthma, unspecified; esophageal reflux; irritable colon; contact dermatitis and other eczema, unspecified cause; osteoarthritis, localized; osteoarthritis, unspecified multiple sites; pain in joint, site unspecified; pain in joint, lower leg; pain in joint, multiple sites; lumbago; myalgia and myositis, unspecified; other insomnia; other and unspecified sleep apnea; malaise and fatigue; other general symptoms; rash and other nonspecific skin eruption; headache.

DEPARTMENT OF THE ARMY
US ARMY MEDICAL RESEARCH AND MATERIEL COMMAND
504 SCOTT STREET
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REPLY TO
ATTENTION OF:

MCMR-RMI-S (70-1y) 21 Feb 03

MEMORANDUM FOR Administrator, Defense Technical Information Center (DTIC-OCA), 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218

SUBJECT: Request Change in Distribution Statement

1. The U.S. Army Medical Research and Materiel Command has reexamined the need for the limitation assigned to technical reports written for this Command. Request the limited distribution statement for the enclosed accession numbers be changed to "Approved for public release; distribution unlimited." These reports should be released to the National Technical Information Service.

2. Point of contact for this request is Ms. Kristin Morrow at DSN 343-7327 or by e-mail at Kristin.Morrow@det.amedd.army.mil.

FOR THE COMMANDER:

PHYLLIS M. RINEHART
Deputy Chief of Staff for
Information Management

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